missiles and rockets

THE MISSILE/SPACE WEEKLY

Berlin War Game Shows U.S. Depends on A-Missiles

- NASA Presses Orbital Flight
- OSO to Eye Center of Sun
- Princeton's R&D Community

Rocketdyne Tests Nova's F-1 Engine

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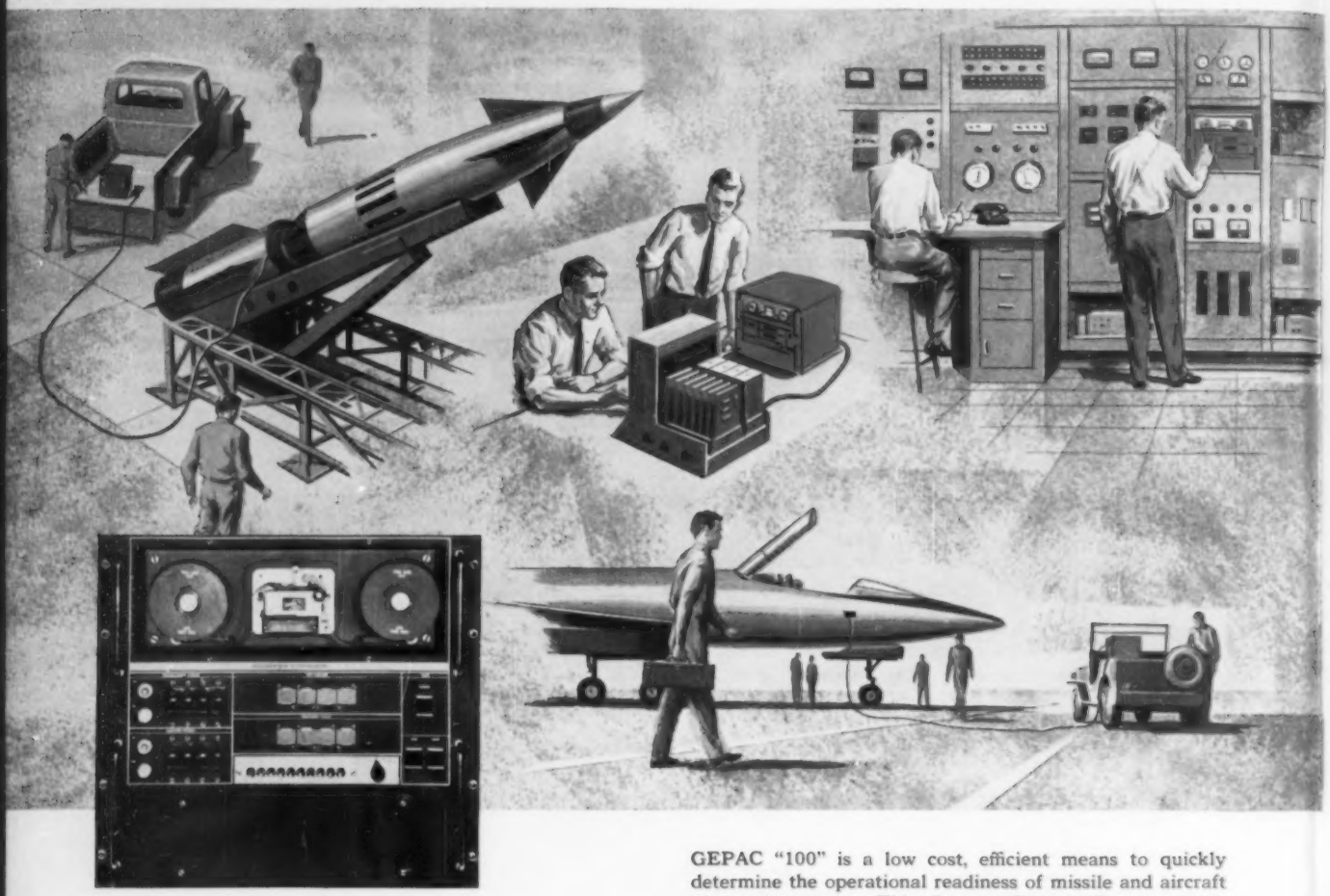

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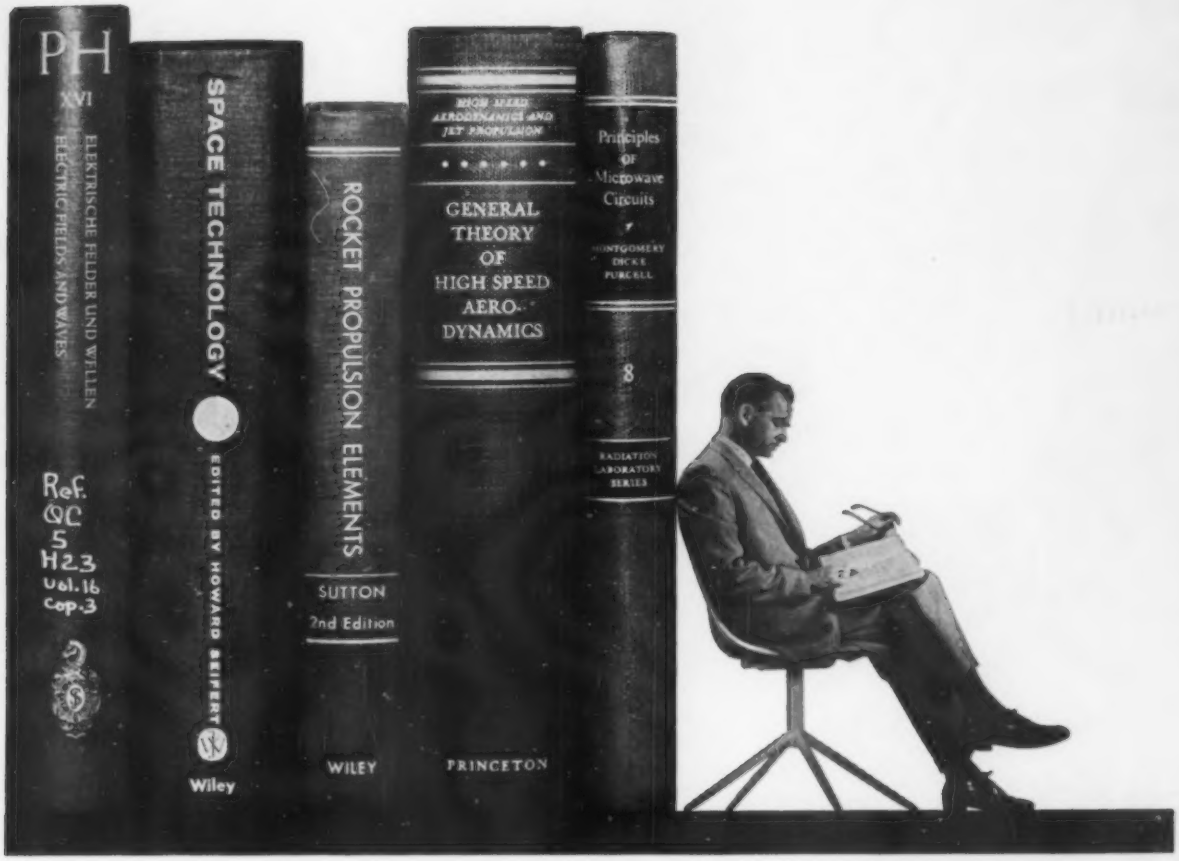

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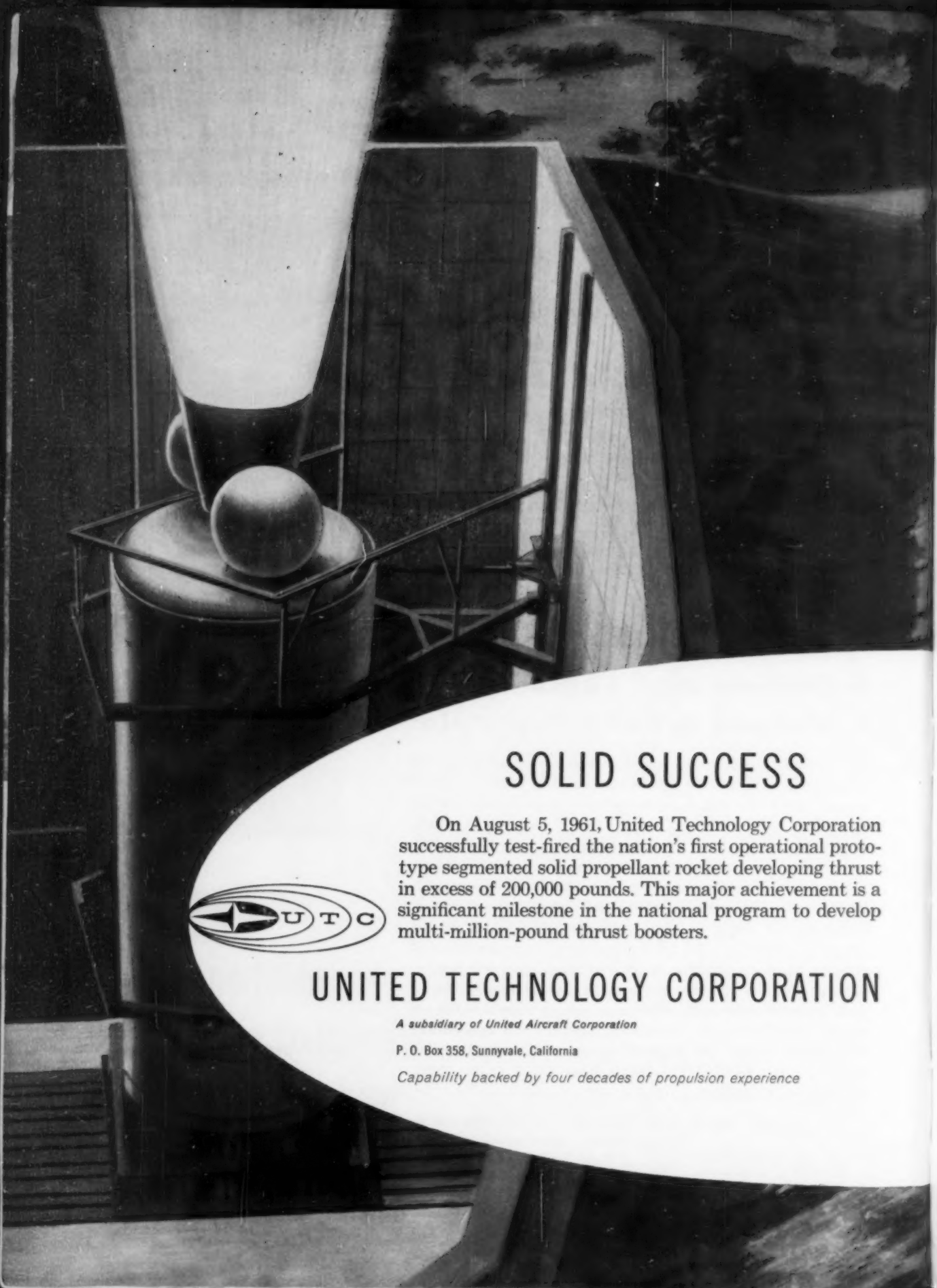

SOLID SUCCESS

On August 5, 1961, United Technology Corporation successfully test-fired the nation's first operational prototype segmented solid propellant rocket developing thrust in excess of 200,000 pounds. This major achievement is a significant milestone in the national program to develop multi-million-pound thrust boosters.

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THE MISSILE / SPACE WEEKLY

missiles and rockets

Volume 9, Number 8 August 21, 1961

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THE COVER

More than a million pounds of thrust roars from Rocketdyne F-1 engine during first series of tests of complete flyable system developed for NASA's Nova. See. p. 10.

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† U.S. Reg. Pdg.

35,251 copies this issue

The stockholders of Chance Vought Corporation and Ling-Temco Electronics, Inc., on June 30, 1961, approved plans for combining these two companies into a vast new company — Ling-Temco-Vought, Inc., to be effective August 31, 1961.

Combination of these dynamic, experienced organizations will link depth of capabilities with depth of management to meet the advanced challenges of electronics, space, communications, aircraft, and missiles.

Ling-Temco-Vought will employ more than 20,000 people in the development and production of: AEROSPACE SYSTEMS . . . ELECTRONICS . . . COMMUNICATIONS . . . SOUND SYSTEMS . . . AERO SYSTEMS . . . INFORMATION HANDLING SYSTEMS.

This will be . . . . Ling-Temco-Vought, Inc. . . . a new industrial leader to serve America's future through science.

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LTV

*Proposed new name for the combined companies after August 31, 1961. CHANCE VOUGHT CORPORATION AND LING-TEMCO ELECTRONICS, INC.

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letters

Soviet Bombers

To the Editor:

I am against dull, loaded TV exercises, which your editorial (M/R, Aug. 7) describes the recent LeMay panel as being. I did not view it, but if it is as you report, I can't see where you're wrong in your view.

On the other hand, I can't go along with an earlier editorial (M/R, July 31) in which you brush aside all these Russian planes shown at Tushino as "old stuff."

They may be. But as an old aviation reporter who's been up in some of our best planes, and owner of a Mach-buster pin, those Russian machines looked mighty ominous to me. Particularly the Beauty and the Bounder. My God—I hope you are right! I hope the Russians do not have a big fleet of these planes, because stopping them looks like a very tough job to me.

One thing I would like to know. Why does it take us so long to wring the bugs out of a new plane? I've been doing pieces on the F-105—years and years ago I really waxed wild on this machine—and so far as I know, after years and years and years, the damned thing is *still* not free of black-box trouble.

I wouldn't sell planes short, though. I'm still not convinced these missiles can hit with the kind of accuracy you need to do the job--particularly over long ranges, and so far as the *Polaris* is concerned, if it hits it's the greatest, but how in the world can it hit from the bottom of the sea if we can't even fire an astronaut with accuracy from dry land over a vacuum-cleaned, ribbon-festooned prize course?

Frank Harvey
Hackettstown, N.J.

Reporting in Depth

To the Editor:

18,000 fathoms of water!!! ("MR-4 Winds up Suborbital Series," M/R, July 31, p. 16). At 6 ft./fathom your article leads one to believe that the Atlantic Missile Range has a water depth of 108,000 feet!! This exceeds the previous known Atlantic depth record (Milwaukee Deep off Haiti, 30,246 ft.) by a factor of about 3.5. Surely you mean 18,000 *feet* of water. How many *Mercury* capsules full of mail did you receive on this boner?

Thank you for a usually fine publication.

Henry W. Wedaa
Head, Ordnance Applications Dept.
Aerojet-General Corp.
Downey, Calif.

To the Editor:

Congratulations on M/R's amazing announcement of the outstanding ocean deep of all time! We had always thought the Mindanao Trench at approximately 6200 fathoms was the greatest depth known—but it doesn't hold a candle to 18,000 fathoms!

Even if the *Liberty Bell 7* capsule had fallen into the Puerto Rican Trench it could hardly have sunk any deeper than 4500 fathoms, unless it was powered to drill into the floor.

We have been a steadfast subscriber since Issue No. 1 and look forward to each issue with interest, but don't shake our faith in the veracity of M/R's coverage of aerospace activities. After all, the current run-of-the-mill news in this field is sensational enough without attempting further embellishment.

Franz Joseph Schaubelt
Member, I.A.S.
La Mesa, Calif.

To the Editor:

If memory serves me the deepest depth of the ocean is something like 35,000 *feet*. The newscasts at the time gave the same depth—18,000 fathoms. Should this have been 18,000 feet?

Thank you very much for a splendid job in your magazine.

William T. Rogers
Billings, Mont.

Yes, yes, 18,000 feet. Might as well have been fathoms.—Ed.

Proper Sparrow

To the Editor:

The Fifth Annual World Missile/Space Encyclopedia in M/R July 17 contains data covering the Navy *Sparrow III* missile. The photograph accompanying the specifications shows a group of dollies carrying *Sparrow I* missiles.

THE REAL SPARROW III.

Your encyclopedia is comprehensive and will become a source of reference and authority. We know you will want it to be accurate. You may wish to correct this error by printing the enclosed photograph of the Navy's *Sparrow III*.

Harold Berman
Technical Information Officer
U.S. Naval Missile Center
Point Mugu, Calif.

Ski-Launch De-energized

To the Editor:

This whole Russian ski-launch discussion (Letters, M/R, July 31, p. 6) puzzles

(Continued on page 36)

NEW NAVY... NEW WEAPONS

New naval defense concepts are vital in these days of nuclear submarines and guided missiles. One of these: A destroyer-class hydrofoil boat guided to lurking enemy submarines by remote sonobuoys. Ford Instrument is now working to turn this new concept into operational hardware . . . one of the most recent efforts in our 46 years of service to all branches of the armed forces.

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A CREATIVE TEAM OF SCIENTIFIC, ENGINEERING AND PRODUCTION TALENT

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The Countdown

WASHINGTON

NASA '63 Budget to Hit $4 Billion

Budget estimates being prepared by NASA for FY '63 are expected to call for expenditure of close to $4 billion—more than double the $1.7 billion for the current year. More than half will go to the lunar program.

Jupiters in the Green

All or nearly all of Italy's 30 *Jupiter* IRBM's are now understood to be operational. Earlier this month, Italian Air Force missilemen successfully launched a *Jupiter* from Cape Canaveral in a combat training exercise. It was the second to be conducted.

Polaris: A Super Super?

The Navy is considering the development of a follow-on to the *A-3 Super Polaris*. The Lockheed *A-3* is being designed to have a range of 2500 nautical miles. It is expected to be operational in 1964. The *A-4* Super Super would have a range of 4000 to possibly 5000 miles. Company studies are under way.

New Pressure for Satellite Defense

One significant reaction to the flight of Russia's *Vostok II* is the increased demand within the Armed Forces for a defense against military satellites and spacecraft. One strong source of the increasing push for a space defense system is NORAD.

DOD Electronics Buy Up 37 Percent

Analysis of the final defense budget figures passed by Congress show the FY '62 appropriations bill provides a total of $1.37 billion for the procurement of electronics and communications equipment for all three military services. This is $370 million more than was appropriated for FY '61. The Administration's July defense budget revision alone added $180 million of the total increase.

On the Pad

Technical troubles apparently have been cleared up and NASA expects this week to get off the long-delayed first shot of the *Ranger I* lunar spacecraft from Cape Canaveral . . . From Wallops Island, Va., the backup of the *S-55* micrometeoroid satellite also is ready for flight aboard a *Scout*.

Jobs by Sleight of Hand

Expect NASA to get around the $112-million cut in its FY '62 budget, which included some $20 million in salaries and expenses, by some administrative sleight of hand. Otherwise, the agency won't be able to hire half of the 4900 new employes it says it needs this year. . . . Man-to-know for future NASA programing is D. D. Wyatt, who is heading up a new Office of Programs under Associate Administrator Robert C. Seamans Jr. Wyatt's office will have policy review status in determining what funds will be spent on particular projects—and when.

INDUSTRY

In Search of Apollo Chief

Announcement of a boss for NASA's *Apollo* lunar program is believed to be imminent. For the past few weeks NASA Administrator James Webb has been consulting with dozens of missile/space industry executives, seeking their advice on the type of management the big program should have. Presumably, he's been sounding out some of them on whether they would like the job.

R&D Intelligence

COUNTDOWN hears that specs for the big *Nova*-type solid booster are changing almost daily—much to the bafflement of the solid propellant industry. Still unresolved is the fundamental question of whether it will be a one-piece or segmented motor. . . . RCA has come up with a precision missile and satellite tracker which the company says has an accuracy approaching 5 ft. at 2000 mi. . . . Solution to the ignition problem in small storable liquid rockets now seems in hand, and there reportedly is a quickening of interest in this propulsion area, particularly in the Navy.

GE Awarded Secret Samos Contract

Work at GE's Missile & Space Vehicle Division has been officially tied for the first time to the development of *Samos II*—an advanced version of the Air Force's closely-guarded reconnaissance satellite. The Air Force announced that it awarded GE a $1,133,000 contract for *Samos II* R&D. No further details were disclosed.

Ford Competes for Saturn

Ford Motor Co. is stepping into the competition for the multimillion-dollar contract to build *Saturn C-1's*. A company team is being set up at Ford's Aeronutronic Division, Newport Beach, Calif., under Roy P. Johnson—former Aeronutronic marketing manager and *Shillelagh* missile program manager. Johnson will be assisted by John B. Lawson, manufacturing operations manager of Ford's transmission and chassis division.

UTC's Satellite Booster

A booster being developed by United Technology Corp. for putting communication satellites into orbit will have four stages, all solid-fueled. Described as a "giant *Scout* type," the vehicle has UTC P-1 and P-2 boosters as its lower stages. The two upper stages are smaller motors.

INTERNATIONAL

British Redeye Buy?

Britain is reported considering the purchase of Convair *Redeye* antiaircraft missiles to supplement Army defenses which now rely solely on the English Electric *Thunderbird*. The Army wants *Redeyes* to protect against low-level air attack.

Overseas Pipeline

Jodrell Bank's Sir Bernard Lovell is the first recipient of a $1000 Guggenheim International Astronautics award presented by the International Academy of Astronautics. . . . A VLF transmitter for *Polaris* submarines is being built in Britain as part of the NATO defense network. . . . Some 47 countries are now involved in NASA's international program, many of them just seeking scientific information. . . . The Russians are now showing a film in the West called: "With Gagarin to the Stars."

RPI space age support provides . . .

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JUDI I	66.0 x 3.0	23.8	3,900
PIMA I	33.4 x 5.6	48.8	6,030
HOPI I	80.4 x 4.5	74.4	11,900
KISHA I	72.1 x 6.5	145.0	21,300
KIVA I	106.7 x 6.5	216.0	33,500
GILA III	101.6 x 9.0	396.0	65,500

FOR TECHNICAL DATA on any of these motors, write for Technical Bulletin #1400.

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The Missile/Space Week

DOD Budget: Tomorrow—and Today

Defense Secretary Robert S. McNamara outlined his philosophy of budget-making in newly-released congressional testimony.

"I consider the budget nothing more than and nothing less than the quantitative expression of a plan or policy," he said. "So in developing the budget I propose to start with the plan or the policy and translate it into quantitative terms, terms of benefit or cost."

He assured Congress that this would be the guideline followed in formulating the budget for FY '63.

Meantime, Congress finally passed and sent to the White House the thrice-revised DOD money bill for FY '62.

The bill provides $46.6 billion. It contains all of the successive revisions and additions sought by the Administration plus some three-quarter billion dollars for bomber procurement and B-70 R&D which the Administration has repeatedly said it doesn't want.

Paradoxically, the bill still provides for a 2 percent across-the-board reduction in procurement funds. A total cut of $344.8 million in missile and aircraft funds.

The bill is $6.4 billion higher than the bill for FY '61—$5.8 billion higher than the Eisenhower lame duck bill. It is the biggest peacetime military appropriation bill in U.S. history.

Shots of the Week

• NASA apparently successfully launched last week its *S-3* satellite, designed to study the relation between magnetic fields and space radiation.

Officials at Goddard Space Flight Center—which conducted the test—said that while it would be a couple of days before its orbit could be determined, "everything looks good at this point."

The uncertainty was caused by the satellite's highly elliptical orbit.

• An Army *Pershing* was destroyed 52 seconds after what appeared to be a perfect launch when the missile veered sharply off course. The Army said trouble developed in the burning time of the second stage when the *Pershing* had traveled about eight miles from the Cape.

• Swedish scientists fired a U.S.-made *Arcas* over the Lapland test range at Vidsel on the Arctic Circle Aug. 14. The nose cone was blown up on command at 55.8 miles altitude, sending an artificial cloud nearly 100 miles over the launching platform.

• A 15-ft. *Aerobee* was launched and ignited underwater in what Aerojet-General Corp. calls the first successful achievement of its kind.

Dixon to Replace Ostrander

Thomas F. Dixon, currently Vice President for research and engineering at the Rocketdyne Division of North American Aviation Inc., takes over as director of NASA's Office of Launch Vehicle Programs on Sept. 18.

DIXON

He replaces Maj. Gen. Don R. Ostrander, who is returning to the Air Force as Vice Commander, Ballistics Systems Division Air Force Systems Command. Ostrander has been OLVP Director since Dec. 16, 1959.

Dixon—employed by NAA for the past 15 years—directed the development of liquid propellent engines for such missiles are *Atlas, Thor, Jupiter,* and *Redstone.*

F-1 Test Firing

Rocketdyne has revealed that more than 140 tests at over a million pounds of thrust have been made to date in the *F-1* development program.

The powerful booster, under consideration for use in *Nova,* developed over 1 million pounds of thrust Aug. 16 at Edwards AFB, Calif. during the first series of tests of the complete flyable system (see cover).

F-1 will eventually have a thrust of 1.5 million pounds and a duration of two and a half minutes. A Rocketdyne spokesman said a record thrust of 1,640,000 pounds was achieved in a thrust chamber test. He said Rocketdyne is aiming at a reliability

in the *F-1* "higher than the reliability established by the *Redstone* engine, with only 78,000 pounds of thrust, which carried this country's first astronauts . . ."

X-15 Number Two

The second *X-15* rocket plane had its first test flight Aug. 10, piloted by Navy Commander Forrest Peterson. The NASA experimental craft's flight had been delayed for almost a month by technical difficulties and adverse weather.

Saturn at Cape

The *Saturn* booster is in Cape Canaveral after its 2200 mile barge trip from Huntsville. Workmen immediately began preparations to erect the 82-ft. booster on its pad. First flight test is scheduled for October.

Huge Helium Plant Contracted

The first contract in the Department of Interior's helium conservation program was awarded the Helex Co., a subsidiary of Northern Gas Co.

The first of several plants, to be built under a program which will ultimately save 52 billion cubic feet of otherwise wasted gas, will be at Bushton, Kan. It will be the world's largest helium facility, producing raw helium to be purchased and stored by the Bureau of Mines. The company will be paid up to $11.24 per thousand cubic feet for all helium produced in the plant up to a maximum amount. The 22-year contract calls for delivery of the first helium no later than Jan. 1, 1963.

Echo Satellite One-Year-Old

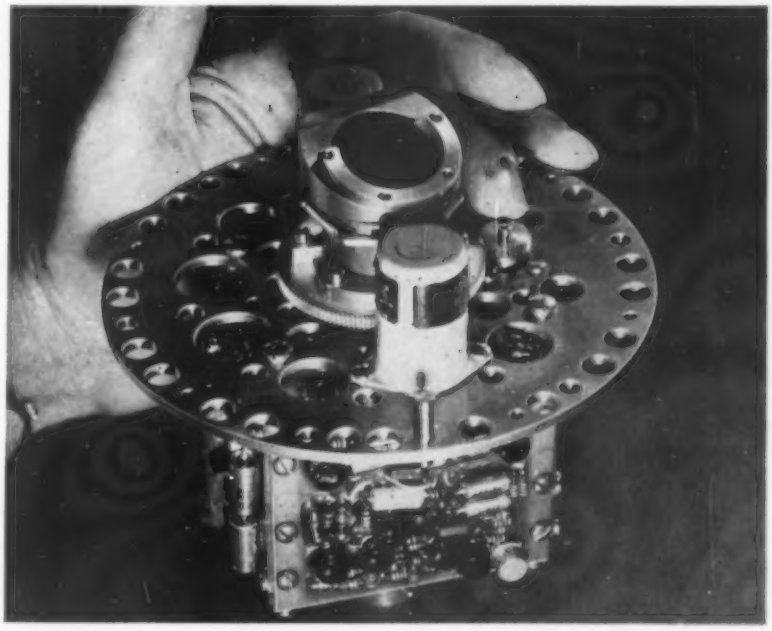
Echo celebrated its first birthday last week and NASA believes the communications satellite may last until midwinter and perhaps another year.

The giant balloon has traveled more than 138 million miles on nearly 4500 trips around the earth. Experiments with *Echo* have virtually halted, but a signal sent a few weeks ago was bounced back, amazing some scientists, who originally predicted a useful life of one week for the satellite.

Bristol choppers help first U.S. Astronaut maneuver space capsule

Four Bristol Syncroverter* choppers formed a vital part of the infrared horizon sensors manufactured by Barnes Engineering Company, Stamford, Conn., and carried aloft in NASA's MERCURY capsule by the first U.S. astronaut to reach outer space.

The Bristol choppers function as sensitive phase detectors in the sensors as they establish a horizontal reference plane for the vehicle.



Infrared Horizon Sensor undergoes rigorous optical, mechanical, and electrical checks at Barnes Engineering Co. One Bristol chopper is located in foreground, in front of gear.

Bristol Syncroverter* choppers, noted for low noise, long life and high reliability, are finding a vital place in more and more missile guidance systems, as well as in analog computers, d-c amplifiers, and test equipment for industrial applications. More than 200 models available. Write for complete details.

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To stop Red masses . . .

West Is Dependent on Nuclear

But Army maneuvers show we are short in adequate tactical missiles as well as lacking in conventional force

by James Baar and William E. Howard

HEADQUARTERS EXERCISE SWIFT STRIKE, FORT BRAGG, N.C.—The Army and Air Force staged a "Little Berlin" dress rehearsal last week in the woods and fields of the Carolinas.

The clear verdict for the short haul:

The use of tactical nuclear weapons by NATO forces on the Central European Front is inevitable if the Red Army moves in force.

The verdict for the long haul:

The Army is almost as desperately in need of more equipment to fight a tactical nuclear war as it is of more equipment to fight a conventional war.

Some 38,000 men and 515 aircraft took part in the big maneuvers which began the week of Aug. 7 with mass airborne landings. The maneuvers were the largest staged in the United States since 1941.

Moreover, the principal participants were the 101st and 82nd Airborne Divisions—two thirds of the Strategic Army Corps, the bulk of the Army's existing combat-ready central reserve, unquestionably the first units that would be sent to reinforce NATO on the Central Front this fall—if the Berlin situation continues to deteriorate.

The participation of these divisions and the Air Force reserve units that would be ordered to support them gave far greater significance to the Exercise Swift Strike maneuvers than they ordinarily would have had. Swift Strike was a dry run played out in the teeth of the increasingly tense international struggle.

The war problem assumed for the maneuvers had many similarities to the Berlin situation. A Communist satellite nation begins to overrun a nation tied to the United States by treaty. The attacked nation appeals for help; the United States responds. The satellite nation, in turn, calls for help from its major power backer.

The similarity with Central Europe is fairly direct: East Germany attacks Berlin or West Germany. The United States comes to the aid of Berlin or West Germany. Russia comes to the aid of East Germany.

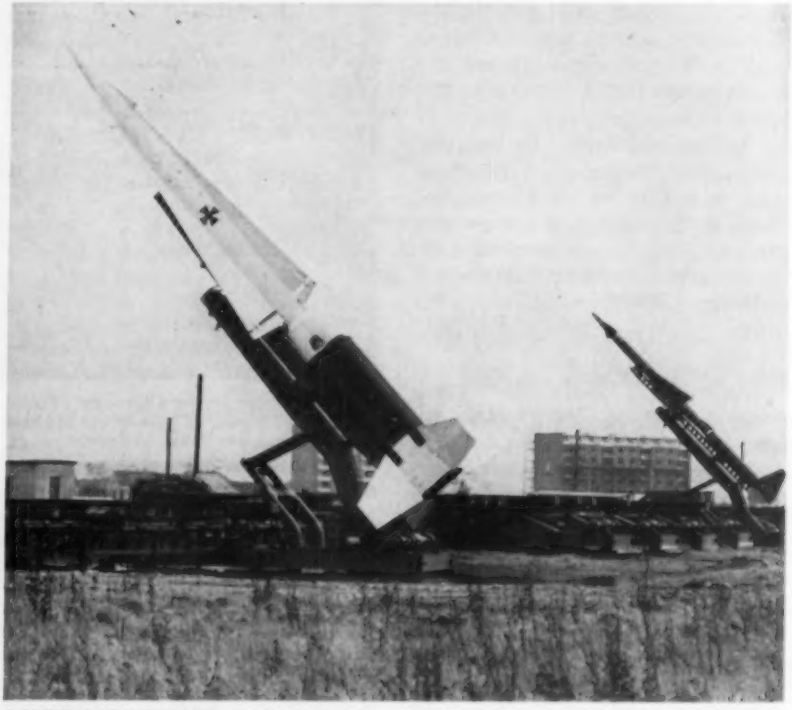
• **Artificial odds**—However, in the problem, both sides were assumed to have the same number of nuclear weapons, the same size Air Force and roughly the same size Army.

In Central Europe today, NATO is considered to have a superior number of tactical aircraft and a superior number of nuclear weapons of various sizes. Russia is considered to be capable of rapidly putting a much larger, far more mechanized and better equipped army in the field.

The equal forces that faced each other in the Carolinas fought with conventional weapons for several days before using nuclear warheads. And, even then, nuclear warheads were not introduced as an absolute necessity.

But, in Central Europe, the tactical trump card of the NATO forces is their nuclear weapons. The trump card of the Communist forces is the rapidly reinforceable Red Army. If the former is not played swiftly, the latter can eliminate it with conventional weapons.

Even a passing hope that NATO forces might hold the Red Army at bay for any length of time with the kind of equipment and conventional weapons employed in Exercise Swift Strike is based on most flagrant pipedreaming.



LONELY SENTINELS are West German Nike-Hercules (foreground) and Nike-Ajax ready on launchers in strategic Rühr Valley. Note German cross on Hercules.

ar Missiles

NATO TROOPS fire Honest John in training exercise. These, like most in NATO's arsenal, are obsolescent birds.

• **Familiar weapons**—For the most part, with a few modern touches, the 101st and 82nd Airborne Divisions re-enacted the Korean War.

The bulk of the airlift for the approximately 12,000 paratroopers who jumped ably into Carolina watermelon patches from about 1200 feet was made up of obsolescent, plodding C-119's and C-123's.

The mainstay of the tactical fighter force that provided air cover for the transports and ground support for the attacking armies was the subsonic F-84.

The 101st fought with newly-issued M-14 rifles, but everyone else carried World War II M-1's. The 101st is the first major unit in the U.S. Army to be equipped with the new rifle.

The *Honest John* was the only missile deployed with the ground forces. Each side had 16. Each side also had four eight-inch howitzers which are capable of launching nuclear shells.

However, *Honest John* is an eight-year-old missile considered to be obsolescent. None of the Army's newer missiles such as *Little John, Sergeant* or *Davy Crockett* were deployed.

In the air, the Tactical Air Command had a handful of F-105 Mach 2 jets which are capable of carrying air-to-surface *Bullpups* as well as nuclear bombs. Other Century Series jets capable of carrying air-to-air missiles and nuclear bombs also took part.

But the F-105's put in relatively few appearances and none with *Bullpups*. The other Century Series planes were far outnumbered by the older types.

The major modern touch in the air was the introduction of TAC's new airborne command post—a redesigned KC-135 jet tanker. The air battle and parachute drops were directed from the command post by a major general and his staff.

The lack of more modern missiles in the field was bluntly pointed out in a fact sheet distributed by the Strategic Army Corps.

"Missiles and rockets are operational in STRAC artillery," the fact sheet said. "But they are either too few or already are outdated by weapons off the drawing boards and tested but not in production.

"In order to fight the limited warfare of today's cold war, modern massive firepower weapons are needed to contain and hold the battle area and check the spread of aggression by fast shifts of men and material to possible new brushfires."

The dire lack of other modern equipment needed to fight both tactical nuclear and conventional actions has been stressed repeatedly by the Army.

• **Problem is quantity**—As late as last March, when the Administration was still shelving Army proposals for greatly increased procurement of modern weapons, Lt. Gen. R. W. Colglazier, Army Deputy Chief of Staff for Logistics, told the House Armed Services Committee:

"We have developed (the M-60 tank) to contend with not only the Soviet main battle tank, the Russian T-54, but also with the latest Soviet heavy tank. . . . We have the qualitative aspects of tank modernization in production; however, it would take approximately 12 years at current production rates to replace our inventory of M-48 Patton tanks and older models with future tank procurement."

"At present rates of procurement several years will elapse before the Army has its acquisition objective for the M-113 armored personnel carrier. Approximately one-fourth of the Army's quantitative needs . . . are on hand or under contract.

"Currently the Army has one-fifth of its needs for the modern (M-14) rifle either on hand or on order. . . ."

Finally, he added: "The payoff for material modernization is not realized on the drawingboard but only when the equipment is in the possession of troops and is supported by adequate reserves for combat."

The procurement provided in the latest increases in the FY '62 defense budget will be only a beginning toward providing the missiles and other equipment to make a modern fighting force out of the current 14-division Army.

To add two more divisions as the Administration has indicated it may by alerting reserve units and draft increases will call for still more.

Swift Strike told nothing new: It only dramatized what Army officials have been saying for years. The United States has nothing in ground forces that would be a match for the Red Army in a conventional war. The U.S. tactical nuclear forces can stop the Red Army—but much more is needed quickly. ⌘

Nuclear Dry Run

Exercise Swift Strike gave the Army an opportunity to test its logistics system for nuclear-tipped missiles in the field.

A total of 32 *Honest Johns* were deployed with ground forces during the maneuvers. Each side had 16.

The *Honest Johns* were brought into rear areas by Air Force cargo aircraft and were stored at three centers called SASP's — Special Weapons Ordnance Points.

One SASP was at the rear of the red army; one at the rear of the blue; a third in a rear area available to both sides.

Officially the missiles were corps weapons allocated to division commanders. The commanders, in turn, could draw on the SASP's for missiles that had been placed in their control. Meantime, the commanders already had deployed the missile launchers.

When ordered, the missiles were transported to the desired firing points by Army aircraft — helicopters and Caribou fixed-wing planes.

In press interview . . .

Titov Hints Vostok II Has Wings

RUSSIAN SPACEMEN are dropping more broad hints that their orbital spacecraft are winged or have lifting surfaces—but they are still swathing technical details in a fuzzy blanket of secrecy.

The fuzziness was most apparent during a meeting in Moscow Aug. 11 with correspondents by the Soviet Academy of Sciences president Mstislav Keldysh and Major Gherman S. Titov, who orbited the earth for 25 hours Aug. 14.

Both Keldysh and Titov carefully avoided any explicit description of the *Vostok II* spacecraft and its operation. Even so, some new information was disclosed beyond that which followed the flight of *Vostok I* April 12.

One of the hints about the capabilities of *Vostok II* came from Keldysh, who said the cosmonaut could make all the maneuvers required for scientific observations and "land at any point on the globe."

In reply to a question whether the Russians might give some advice to American astronauts, Titov said:

"It is difficult to give advice. We fly quite differently."

• **Nuclear bomber?**—Asked whether *Vostok II* could carry a bomb any place in the world, Titov left the military threat unanswered by replying:

"The Soviet government has repeatedly pointed out in its statements that the space explorations in the U.S.S.R. serve peaceful purposes only. But since I am asked I can say: The *Vostok II* ship is not adapted for carrying bombs."

(The question, which was dropped there, apparently alluded to Premier Khrushchev's boast Aug. 9 that Soviet scientists could build a 100 megaton bomb which could be "launched aloft" —presumably by missile or spacecraft. American officials wrote off the 100 megaton bomb boast, contending the U.S. could build one just as powerful but there was no point in it when a 10 or 20 megaton weapon would be equally effective over most targets. But they didn't tie it to a space weapon.)

At another point, the major said that he took over manual control of the spacecraft after he was in orbit and found "the ship obeyed the controls beautifully; I could orientate it in any direction and send it anywhere at any moment," according to the Tass transcript of the press conference.

Taken as a piece, these statements would indicate rather clearly that *Vostok II* has a closer kinship with a *Dyna-Soar* type spacecraft than with NASA's *Mercury* or *Apollo* vehicles, which are both ballistic in configuration and have very limited maneuverability.

There was no explanation of how Titov maneuvered the spacecraft.

• **Choice of landings**—One new piece of information revealed by Titov was that he had a choice of landing in the spacecraft or landing by parachute after ejection in his seat from the cabin at a low altitude. He said he chose the latter method. Escape capsule ejection with parachute landing is being considered for both *Dyna-Soar* and *Apollo*, but there is no way of determining if they would be comparable to the *Vostok II* mechanism.

Titov, who said the spacecraft could have held two persons but was not designed for it, indicated that he kept the helmet of his spacesuit open most of the time. He said the air in the cabin was "better than in our cities."

A space medicine expert from the Soviet Academy of Sciences, Prof. Vladimir I. Yazdovsky, disclosed that like *Vostok I*, *Vostok II* was equipped to maintain the occupant for 10 days in space.

Yazdovsky said Titov's otolith organ in his inner ear, which controls the sense of balance, was temporarily affected at the beginning of the flight, causing Titov "unpleasant sensations." He said they disappeared when Titov avoided sharp movements of his head. ¤

F-1 Engine Configurations Unveiled

POSSIBLE BOOSTER combinations using the Rocketdyne F-1 engine—including the Saturn C-3—were revealed last week by NASA's Marshall Spaceflight Center. The various combinations apparently are designed for lifting a 50 to 70-ton Apollo spacecraft to the moon.

First step in speed-up . . .

NASA Goads Mercury Orbit Program

MA-4 launch schedule moved up by about two weeks; but officials concede that manned flight may slip to '62

by Hal Taylor

NASA IS QUIETLY applying pressure to the trouble-dogged *Mercury-Atlas* program in hopes of getting an American into orbit this year. The speed-up—along with efforts to get the *Apollo* lunar program off the deck—is in reaction to the latest Soviet orbital flight.

The first step is due this week with the unexpectedly early scheduled launch of the *MA-4*, an unmanned *Mercury* capsule, into earth orbit. If completely successful, the shot will greatly enhance chances for a manned orbital flight in 1961.

At the same time, the space agency has decided to speed development of the *Saturn C-3* booster by holding a bidders conference within the next two weeks on its S-I first stage (M/R, Aug. 7, p. 13).

This means that the contract for the *C-3*—designed to lift a three-man *Apollo* spacecraft into manned flights around the moon—could be awarded by Oct. 1, also far earlier than planned.

All missile/space firms in the booster business will be invited to the conference. NASA officials said that it is likely that one firm will be picked to build the first stage of the *Saturn C-3* and the earlier version, the *Saturn C-1*.

• **Cautious go-ahead**—The decision to schedule an early *MA-4* shot followed a series of meetings at which Project *Mercury* officials reported that checks and tests of the *Atlas* booster and *Mercury* capsule were going well with all parts working smoothly.

MA-4 was first scheduled for the end of August or the first week in September, which allowed for the normal six-week period of testing the vehicle on the launch pad.

In an effort to save as much time as possible, NASA officials gave the go-ahead for the flight after about four weeks of checking.

With only two more shots definitely on the *Mercury* drawing board—an orbiting capsule with a monkey aboard and the manned orbital flight—it is still possible Project *Mercury* could come to a successful conclusion this year.

• **Highly iffy**—NASA officials admit privately that the success of such a timetable is doubtful, and that the manned orbital flight is still likely to go over to 1962.

Thus far, two out of three shots in the *Mercury* program using the *Atlas* booster have been unsuccessful. *MA-1* blew up on its pad and *MA-3* developed programmer trouble and had to be destroyed shortly after launch.

The success or lack of success of *MA-4*, therefore, will determine the *Mercury* timetable. If any problems develop in the flight, the shot will have to be repeated. The same procedure applies to the other scheduled *Mercury* shots.

• **Itinerary**—*MA-4* will use the capsule which was recovered after the aborted *MA-3* flight.

It will be lifted from its pad from Cape Canaveral by an *Atlas D* booster developing about 360,000 lbs. thrust. Its heading at launch time will be 70 degrees.

The sideboard engines on the *Atlas* will cut off 2½ minutes after launch; the main sustainer engine will shut down after five minutes.

According to the flight plan, the capsule will orbit the earth once and then land.

Its injection into orbit will occur five minutes after launch at an altitude of approximately 100 miles while passing over Bermuda. During the flight, the capsule will pass over Bermuda, Canary Is., North of Zanzibar, Indian Ocean, Australia, Southwest Pacific, Mexico, Texas, Louisiana, Alabama and Georgia.

The capsule will reach its apogee just off the west coast of Australia at an altitude of 150 miles.

Firing of its retrorockets will be automatic just off the west coast of Mexico. If the automatic signal fails to work, a backup signal will be sent from Wallops Is., Va.

As the capsule descends to its impact area off the coast of Bermuda, it will start encountering the atmosphere and resulting heat at an altitude of 50 miles. This will continue for about 20 miles.

Total flight time has been estimated at 90 minutes.

• **Different hatch**—Space agency officials said it has not yet been necessary to make any changes in this *Mercury* capsule as a result of the recent flight of Capt. Virgil Grissom in the *Liberty Bell 7*.

The officials points out that the capsule to be used, No. 8 in the *Mercury* series—is not fitted with the explosive hatch which caused so much trouble in the Grissom flight.

The *MA-4* capsule is fitted with the "bultog" hatch which was operational on all early versions of the *Mercury* capsule. The explosive hatch will be used on the capsule which the American astronaut will ride into space.

Space agency officials report that there is nothing wrong with the explosive hatch that a slight change in operating procedure will not cure. This involves leaving the firing pins for the hatch in until the astronaut is ready to leave the capsule.

The officials also said that no changes are planned in the recovery operation. About three Navy ships will be used and three helicopters will retrieve the capsule.

Main piece of equipment in *MA-4* will be the "man simulator." This will breathe in oxygen and exhale carbon dioxide as a human astronaut would do. It will create the same heat and humidity as a human in a test of the capsule's life support system.

Other equipment will include an earth-sky camera, another camera which will take pictures through the periscope, and one camera to film the instrument board. ⌗

Site Labor Dispute Procedures Streamlined

NEW PROCEDURES for handling union jurisdictional disputes at missile sites have been announced by the National Labor Relations Board.

The changes, designed to permit prompt hearings and reduce red tape, shorten to ten days the period between filing of any charge of unfair practices and the holding of a board hearing.

In the past, the procedure has often been spread over a number of weeks.

The speed-up will also be applied to defense establishments other than missile sites. ⌗

Machine 'Taught' to Recognize Sub Sounds

Raytheon's Cybertron equals human ability to sort out noises; remembers when it's 'punished' for its errors

A MACHINE that learns by its mistakes is already being taught to distinguish such phenomena as the "essence" of submarine sonar signals as well as expert human operators.

Called the "Cybertron" and developed by Raytheon Co., the machine is "educated" by being exposed to data in a specific field, modifying what it has already learned, and storing new data on its memory element. From each experience, the machine absorbs all it needs to know in seconds.

A smaller model of the machine, the K100, is working on military problems under contract with the Department of Defense. Cybertron K200, now in final stages of development, is a much larger learning machine designed to recognize speech sounds. When fully developed, Raytheon says, it will be able to recognize and type out all typical American word sounds by using its 192 learning elements.

The small machine (K100) uses punched tapes for learning, as well as for its memory element. A tape about one ft. long can store all it learned about dozens of cardiograms and sonar identification.

When the machine makes a mistake in learning, the teacher pushes a "goof" button. This results in "punishment"—making the machine re-evaluate its method and adjust its memory content. The teacher tells it nothing except that it erred. He can, if necessary, point out the correct answer. When it responds correctly, the K100 is rewarded by being allowed to continue operation uninterrupted.

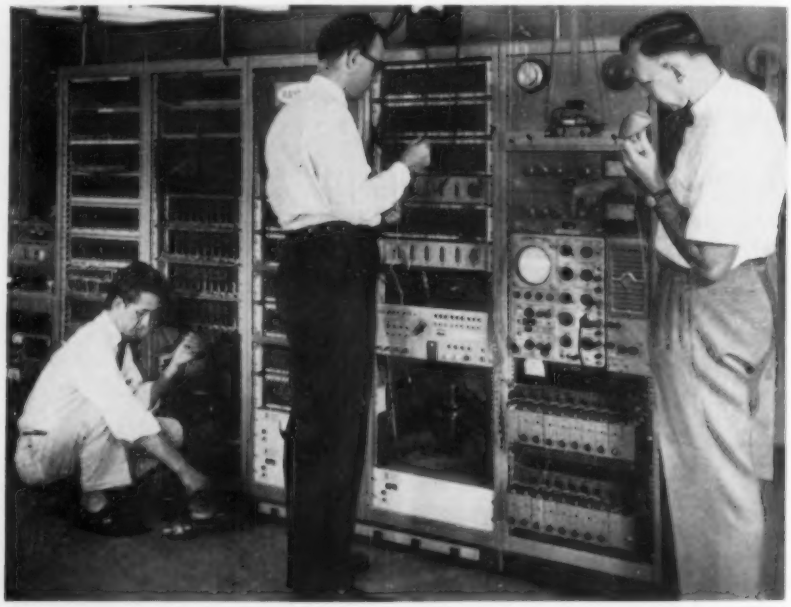
• **Learning process**—Here is a simplified example of the way the machine might be taught to recognize sonar signals from a submarine:

Sonar sounds—perhaps from a shrimp breeding ground—are fed into the Cybertron. The machine's memory drum is blank at this point and has zero correlation with the signal. It thus makes no response, which is correct.

Next, a submarine signal is sent through; there is again no response. Whereupon, the human instructor pushes the "goof" button; the Cybertron records the sonar signal on its memory. The next time such a signal passes through, the machine will recognize it for what it is.

The memory is now modified until it contains the essence of the class of submarine sonar signals. Suppose the signals from a surface ship are fed to the Cybertron. This signal contains some of the signature of the submarine signal. The machine calls it a submarine.

The human instructor points out the error to the Cybertron and the machine "subtracts" the surface-ship signal from the submarine signal already on the drum. In effect, then, the Cybertron now has on its memory a signal closer to the "essence" of submarine than it had before. Repeated lessons of this kind will teach the Cybertron to recognize underseas craft quickly and efficiently—at least as well as fully experienced sonar operators would do. ⌗



LEFT: *When Cybertron makes mistakes, human instructor "teaches" it by pushing "goof" button.* **ABOVE:** *Larger version is designed to type out speech sounds it "hears."*

Hughes to build SYNCOM . . .

NASA Likely to Order Fourth ComSat

NASA may become involved in a fourth active repeater communications satellite.

Plans are being drawn, MISSILES AND ROCKETS has learned, for a follow-on to Project *Relay*. If given a go-ahead—and this seems likely—NASA would invite bids from industry about the beginning of next year. Launchings of the new satellites would commence in late 1963 and continue through 1964.

Disclosure of the new NASA enterprise follows an announcement by the space agency last week that it had selected Hughes Aircraft Corp. to build an experimental synchronous ComSat similar to the Army's *Advent*. Last month, NASA made an agreement with American Telephone & Telegraph to launch two to four AT&T-developed experimental ComSats.

The four programs apparently will round out NASA's effort in the communications satellite field—at least for the present.

Although quite similar to the RCA-built *Relay*, the satellites in the proposed follow-on program will have some different characteristics. Among those presently being considered:

—A higher orbital altitude—perhaps 6000 miles—than Project *Relay's* altitude of 3000 miles.

—Two transponders (receiving and transmitting radio systems) may be included as part of the satellite equipment to increase its capacity to transmit messages. This will apparently mean an increase in the weight of the capsule.

—The inclination may be changed to increase the number of countries which can take part in communication experiments with the satellite. The elliptical orbit of Project *Relay* with its inclination of 48 degrees lends itself very well to transmission of messages on both sides of the Atlantic, but almost precludes messages from Pacific areas.

—The frequency of signals from the ground station to the satellites may be increased from *Relay's* 1725 mc.

• **Forerunners** — NASA's contract with Hughes calls for the building of at least three of the experimental synchronous communications satellites at a cost of $4 million.

The small, 50-lb. satellite would be a forerunner of what some experts believe will be the ultimate space communications system.

Such a so-called synchronous system involves placing satellites into an equatorial orbit approximately 22,300 miles above the earth. Because such satellites would travel at the same speed as the earth's rotation, they would remain over the same spot on the earth.

The Hughes satellites—dubbed Project *SYNCOM*—will be launched on three-stage *Delta* vehicles and be guided into a 22,300-mile-high orbit by an additional solid-propellant rocket attached to each spacecraft.

The first launching is scheduled for late 1962.

The satellite will not go into a truly stationary orbit because its trajectory will not be around the equator. Instead, it will be declined 33 degrees from the equator, resulting in an orbit roughly over the same longitude off the East Coast.

Although *SYNCOM* will not supply truly stationary satellites, the space agency said the project will provide "early experience" with an active communications system in a high-altitude orbit. At such altitudes, the effects of the Van Allen belts can be measured.

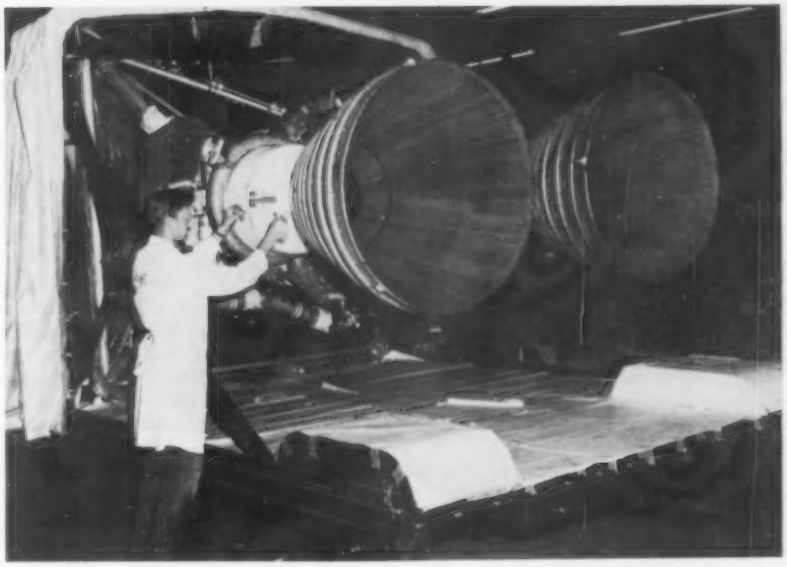
All of the other communication satellite projects are random-orbit low-altitude systems under which as many as 40 satellites are put into orbits about 3000 or 4000 miles high. The large quantity of satellites is necessary because the low altitude means that the sending and receiving period of each satellite is reduced appreciably.

SYNCOM satellites will be designed to relay telephone conversations and telegraph messages over near-hemispheric distances. They will not, however be capable of carrying television bandwidths because the frequencies used will be only 8000 megacycles from ground to satellite and 2000 megacycles from satellite to ground.

The *SYNCOM* program will be managed by NASA's Goddard Space Flight Center.

The Department of Defense, using Project *Advent* facilities under the direction of the U.S. Army Advent Management Agency, will participate by furnishing ground stations and performing communication experiments.

The Space Agency said that arrangements for joint NASA-DOD participation have been made in order to provide the most economical use of existing facilities and expand the national communication satellite research and development effort. ⌗



First Production Engine for Titan II

FIRST-STAGE ENGINE for Air Force's Titan II gets final packaging before shipment from Aerojet-General's Sacramento plant, where it was designed and developed.

Left: Test-firing of large, flight-weight solid propellant rockets at UTC Development Center is important phase of multi-million pound thrust booster development program.

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Technical Countdown

PROPULSION

AF Concerned Over Propellant Safety

The Air Force is worried over the lack of sufficient high-energy liquid propellants for safety testing—with particular accent on large-scale toxic vapor and spill tests. Proper safety provisions are now being estimated; the Air Force would like more thorough testing. The need for these studies was tragically illustrated recently when an AF technician died and three co-workers were injured by gaseous nitrogen which leaked from a storage tank at an *Atlas* missile launching site.

ASTRONAUTICS

Soviet Telescope Being Readied for '62

A new Soviet radio telescope—the second largest in the world—according to the Russians—is due to begin operating at its site on the river Oke next year. Essentially a cross-shaped antenna formed by parabolic cylinders, the telescope was designed to solve the problem of the optimum correspondence of the sensitivity of the radio telescope with its resolution. The total geometric area covered by the telescope is 80,000 square meters; each of the parabolic cylinders is one kilometer in length and 40 meters wide.

Orbiting Repairmen to be Gyro-Stabilized

A free-floating, orbital space worker will be equipped not only with rocket propulsion devices to move him around in space but also with an unrestricted, free-floating mass to provide a comparative reference between his movements and forces being exerted on a surrounding structure. Four basic maneuvers would be required, according to a recent WADD report: rotation to proper flight path, translation between desired positions, rotation during arrival at a work station and stabilization in that final position.

ADVANCED MATERIALS

Air-Stable Titanium Powder Produced

Consolidated Astronautics is preparing to market an air-stable titanium metal powder which, unlike previous titanium powders, is not highly reactive with air. The stabilized form is produced from a film of titanium suboxide, only a fraction of a micron thick, to protect the balance of the pure metallic titanium particle against its normal affinity for the oxygen of the air.

Automation to Speed X-Ray Crystallography

A new technique—developed by Dr. S. C. Abrahams of the Bell Telephone Labs—should significantly accelerate research into the atomic structure of crystals. The new X-Ray diffraction process—called PEXRAD for Programed Electronic X-Ray Automatic Diffractometer—feeds data readings from the crystallographic experiment to a high-speed, general-purpose digital computer which correlates the information, corrects for experimental factors, and prints out crystallographic data in a convenient form for analysis.

Facilities to Produce Beryllia

Facilities in the New Jersey plant of the National Beryllia Corp. have been installed to allow the company to supply high-purity beryllia and alumina shapes metallized and plated on one or more surfaces, printed circuits on beryllia or alumina, and brazed ceramic-to-metal assemblies. Hydrogen furnace brazing will be used, so that customers can do their own high-temperature brazing to main assemblies.

ELECTRONICS

Pattern Recognition Device Under Study

The Air Force's Aeronautical Systems Div. at WADD has awarded a contract to the Laboratory for Electronics to "perform research on a self-organizing pattern recognition device." Essentially duplicating the actions of the eye in focusing an object on the fovea, the system will comprise a pickup—a mosaic of photocells capable of redirecting its movements in response to commands from within the recognition device. It is expected that the device will be useful in recognition of complex patterns such as handwriting and cloud formations.

Isotope Electrodes for Fuel Cells Revealed

Electrodes treated with radioactive isotopes have produced a marked decrease in polarization—permitting a current density of 150 ma/cm^2 to be sustained for extended time periods. Designed by Yardley Electric Corp., the fuel cell electrodes—made of sintered porous silver—permit construction of a simplified fuel cell more resistant to environmental stresses than those previously designed.

Maser Light Amplification Measured

In an experiment designed to observe and measure the light amplification of a pulsed ruby optical maser, scientists at the Bell Telephone Labs have observed a light amplification factor of two. Previously it had been difficult to distinguish the coherent maser light from the natural fluorescent light of the maser. This problem was solved by using a ruby maser oscillator to generate light which was so bright that the amount of fluorescence from the amplifier ruby was comparatively small. With more precise experimental set-ups and greater temperature control, even greater amplification is expected.

SUPPORT EQUIPMENT

AMR Tracking Capability Being Updated

A unique conical-scan feed now under development will be used to modify Atlantic Missile Range tracking antennas to provide complete coverage of the 100-1000 mc frequency band. The new broadband feeds—to be installed on existing 60-ft. TLM-18 antenna at Canaveral and down-range stations—are being built for AFMTC by Dynatronics. A bonus capability of the feed is its ability to cancel unwanted modulation of telemetered signals caused by missile roll and spin.

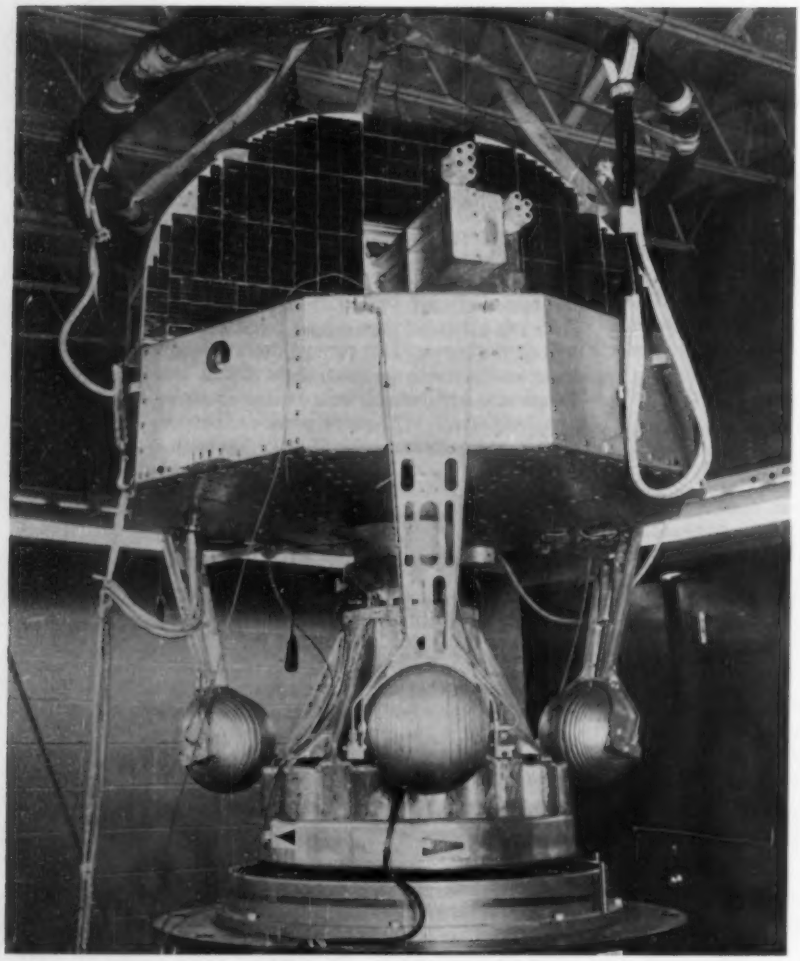
APL Develops Tiny Electrical Meter

An extremely low-power-meter—developed by engineers at APL for the submarine testing program of the *Polaris* missile system—is capable of checking the most sensitive explosive bridgewire circuits without fear of igniting the charge. Generating an extremely low current by the light of two small "grain-of-wheat" incandescent lights shining on a silicon photocell, the meter can measure resistances in the order of 0.1 to 10,000 ohms. New versions of the system are being developed for checking warheads, transistorized circuits, and special missile launching functions.

OSO Will Eye Sun's Center to Start

NASA to put maximum possible number of experiments aboard Goddard satellite; launch may mark man's first aiming of instruments from above atmosphere at precise area

by William Beller



GODDARD'S S-16 SATELLITE undergoing environmental test at Ball Brothers, Boulder, Colo. The two clusters of "eyes" mounted on the pointing instruments—which intersect the fan-shaped solar-cell array—are sensing detectors for positioning the S-16. The Medici-like balls contain nitrogen gas for attitude-control jets.

EARLY THIS FALL an instrumented satellite is to be launched into a 300-mile orbit by a *Thor Delta* to start a systematic study of the sun.

Swinging in a near-equatorial plane and pointing its primary instruments at the sun's center, this *Orbiting Solar Observatory (OSO)*—or *S-16* satellite—will collect data which will be correlated with terrestrial effects observed at ground stations.

Out of this work may come an understanding of the fundamental nature of the sun. Given this fuller basic knowledge, we would then have little need to examine solar symptoms—such as the ionosphere, Van Allen belts and auroral displays—in order to establish the nature of the sun.

• **Shot-gunning the sun**—Sun-earth relationships probably excite space scientists today more than any other area of investigation. This may be so because among all of the space sciences —which today are expanding at about the same rate as the nuclear sciences did after World War II—those dealing with the sun clearly can yield the most practical results.

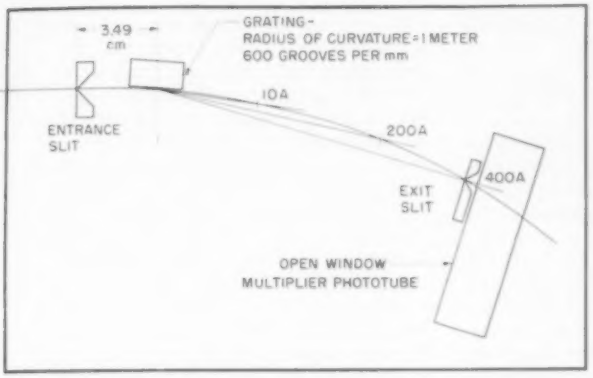
For example, at the last meeting of the International Union of Geodesy and Geophysics, in Helsinki, it was shown that the amount of ozone in the upper atmosphere varies with solar activity. Scientists have long felt that the ozone content has a strong effect on atmospheric circulation and weather disturbances in the lower atmosphere. Thus, one of the solar mechanisms which churns up our weather may have been revealed, and probably will be used in future weather studies.

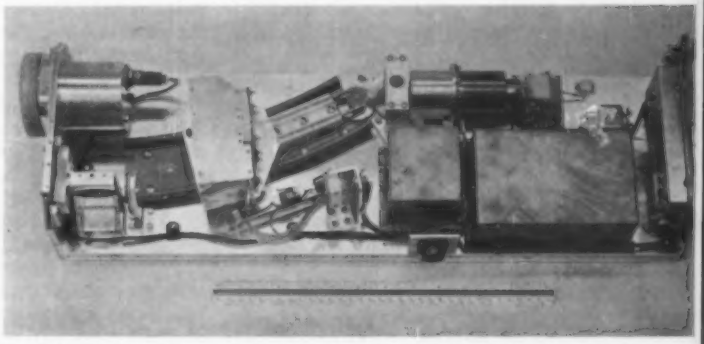
Furthermore geophysical research in general gets its fundamental inputs from solar data. And there are the solar effects on radio communications, magnetic storms and Van Allen belts—well known but little understood.

For all of these reasons, scientists at the National Aeronautics and Space Administration's Goddard facility—where the *S-16* is being monitored—are loading the satellite with as many different scientific instruments as it can efficiently carry.

• **Pointing at a quiet sun**—The *S-16* is being sent up chiefly to collect information on sun spectra in the ultraviolet and X-ray bands. For the first

Search for Basic Solar Knowledge





X-RAY SPECTROMETER for S-16 will use a grazing incidence concave grating of one-meter radius of curvature. A wavelength interval of from 10 to 44 Angstroms will be covered by a mechanical scanning system. Over this wavelength interval the resolution will be about one Angstrom. The instrument will be about 3 x 8 x 24 in., and weigh less than 20 lbs. It is planned to use an open-windowed multiplier phototube utilizing a tungsten photocathode for the detector.

time, these data will be gathered during a predicted quiet period—so that comparisons may be made when the sun is more active.

These experiments require that certain scientific instruments be pointed at the sun's center to an accuracy of one minute of arc. Hence, the *S-16* comprises two sections: a spinning, wheel-like structure to give stability, and on top of this a sun-seeking structure containing the pointing instruments.

Another important reason for launching the *S-16* is to test the performance of the sun-pointing structure. If the experiment succeeds, this will be the first time that man has been able to aim his instruments precisely at a given area—whether sun, star or any other body—from a point above the earth's atmosphere. The advantages of intensive area investigations are obvious.

If the *S-16* fails, it has a backup in the *S-16A*. Then, in about a year, the launching of *S-17* will initiate a second-generation *OSO*.

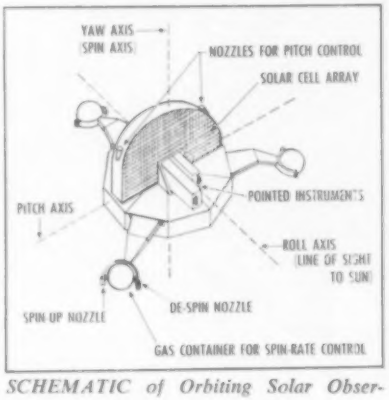
Only a few details have been disclosed about the *S-17*. The men mainly responsible for *OSO* designs are Laurence T. Hogarth, Goddard's project manager for the orbiting solar observatory program; and Dr. John C. Lindsay, associate division chief of Goddard's space sciences division.

They say that the *S-17* will be doing much the same work as the *S-16*, but with one important modification: on command, the *S-17's* pointing instruments will scan the sun to give an image something like a television picture. The raster, made up by horizontal traces one minute apart, will be 40 minutes square. (The sun's diameter is 32 minutes.) This technique is expected to yield an integrated picture of some of the solar radiations.

• **A solar program**—The overall study of the problems of solar weather and its terrestrial effects was outlined by Dr. Homer E. Newell, National Aeronautics and Space Administration's deputy director of space flight programs.

First, Newell says, we must study the sun's surface by instruments such as those being put into *OSO's*.

Next, "we must send space probes into the interplanetary regions to detect the changes produced in the interplanetary gas as clouds of solar particles sweep across the space between the sun and the earth." *Pioneer V* has already found some answers to this part of the problem; and the *Ranger* series of spacecraft will be carrying instruments designed to get more of the answers.



SCHEMATIC of Orbiting Solar Observatory.

Third, "we must measure the magnetic field of the earth and the changes in the properties of the atmosphere, over long periods of time, and correlate the observed effects with solar activity." He pointed out that these observations will be made by instruments mounted in *Orbiting Geophysical Observatories (OGO's)*. A special satellite for these purposes, to be launched within a year, will in effect be a forerunner of the *OGO's*.

• **How OSO works**—The overall height of the *S-16* is 37 inches, and its total weight is about 440 lbs. Its hoped-for active life is six months. The satellite was designed to make maximum use of the payload volume of the *Thor Delta* launch vehicle.

Thus, the wheel diameter of 44 inches is the largest allowed by the *Thor Delta's* shroud. Three Fiberglas spheres filled with pressurized nitrogen gas for the spin-control system are mounted on arms hinged to the wheel. During launch, these arms are folded down around the third-stage motor—giving the satellite the appearance of a Medici coat of arms.

After payload separation, the nitrogen tanks are extended outward, thereby increasing the *S-16's* diameter to 92

(Continued on page 36)

Next Transit Orbit to be Near Perfect

Navy-ARPA satellite system being modified, chiefly in Able-Star 9 vehicle, to insure even greater accuracy than that of Transit IV-A

by John W. Herrick

LOS ANGELES—When *Transit IV-B* is launched next September, it is expected to achieve the most nearly perfect circular orbit of any satellite ever launched.

Transit IV-A attained an orbital eccentricity of .007, but the project's engineers are talking in terms of increasing this accuracy by an order of magnitude of at least 1.5.

Most of the changes for the future *Transits* have been made in the *Able-Star 9* vehicle. Evolutionary but extensive, they are designed to increase orbital accuracy by extending the range of positive ground guidance control.

• **New guidance**—A major switch in *Able-Star 9* is the use of Bell Telephone Laboratory's Series 600 radio-command guidance system to replace the Space Technology Laboratories' guidance components used in past *Able-Star* stages.

The STL autopilot system in *Able-Star 1* through *8* was slaved to a programer which operated through *Able-Star* first engine cutoff (SECO 1) and the coast phase. A flight-path error, detected by tracking radar, was corrected by a ground command to the appropriate autopilot gyro. The program could be modified at any time up to SECO 1. During coast, the autopilot gyros could be torqued to provide pitch programing and some yaw corrections.

One disadvantage of this technique was that the required corrections for *Able-Star* could exceed guidance system and autopilot capabilities. A second disadvantage was that the corrections consumed extra propellant—limiting the vehicle's payload, among other things.

Use of the new BTL radio-command guidance unit provides trajectory control of the *Thor* booster by supplying an input to the *Thor* autopilot gyros through the stage interface.

The booster now can be guided by ground command to a more accurate position in space prior to booster engine cutoff and stage separation. This change minimizes the amount of correction that must be applied to *Able-Star* flight path.

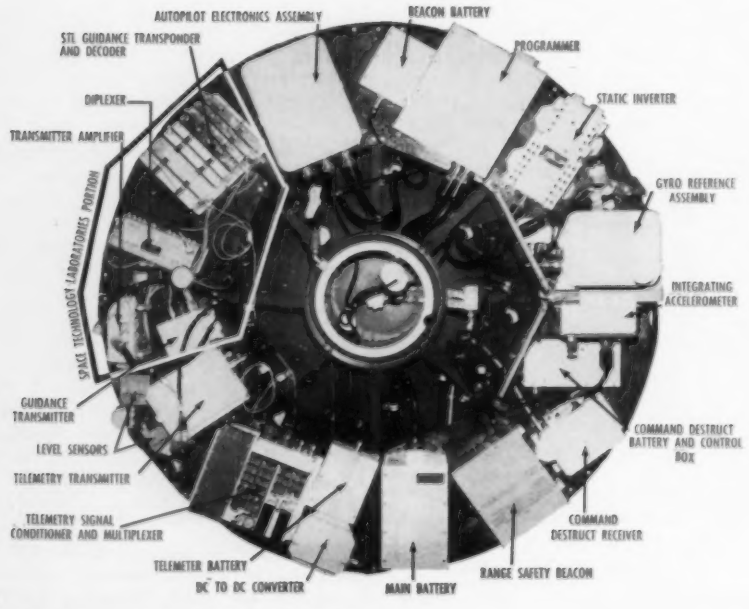
This fall, for the first time in the *Thor-Able* series, the entire launch vehicle will be guided from the time of acquisition—about 5-10 sec. after liftoff—through separation of *Able-Star* from the Douglas booster, and on through initial operation of *Able-Star* engine to the time of first cutoff of the engine.

New components designed, fabricated and packaged by Space-General Corp. will control *Able-Star* attitude through coasting flight, program the restart sequence, control the flight path during *Able-Star's* second propulsion phase, and determine final thrust cutoff (SECO 2).

• **Lighter and lower-powered**—The modifications to *Able-Star 9* include a Space-General-improved autopilot, programer, accelerometer, DC/DC converter and a completely rebuilt and repackaged telemetry system. The components will perform essentially the same functions as the earlier system, but they are lighter and require less power.

The new programer timer design is solid-state. It uses battery power only, and provides a switching capability of 50% more functions than the previous design. The former timer was driven by a 400-cycle motor—necessitating an AC power supply. The new timer is lighter and more reliable. Time accuracy has been improved by an order of magnitude of five.

The modified accelerometer system uses the same sensing element found in previous *Able-Star* vehicles—basically a pendulum mass. Accelerometer DC out-



Details of the Transit IV-B instrumentation.

put controls the frequency of an oscillator, thus changing mass displacement to AC signals.

Able-Star velocity or acceleration will be determined by "counting the cycles" by means of digital electronics. The new accelerometer will also be used to measure velocity during the first *Able-Star* engine firing—a function not included in the earlier systems.

The previous functions—to control engine restart and second thrust cutoff by determining when preselected vehicle velocities are reached—are to be continued. The latter function is critical in the *Transit IV-B's* capability to achieve the most accurate orbit possible. Redesigned accelerometer components are said to provide greater accuracy and reliability without any increase in accelerometer size.

The DC/DC converter boosts 28-volt DC battery power to an undisclosed higher voltage for telemetry.

The new telemetry system incorporates two commutators in place of the single one used previously. CW channels have been increased from nine to 14. The "extra channels" will be used for additional measurements such as tank pressures and vibrational forces.

STL will supply a C-band radar beacon for *Able-Star 9*, to aid in orbit determination of the expended stage. The beacon also permits interrogation of the guidance system after it is in orbit, to obtain information of possible use in future designs.

The single-horn antenna has been replaced by a dual-horn installation to aid ground tracking of the orbiting *Able-Star*. New design will improve the radiation pattern for pickup by worldwide stations regardless of vehicle rotation or attitude. The original one-horn antenna was designed to deliver the best pattern back to Cape Canaveral receivers as the stabilized vehicle approached its radio horizon.

• **Clean break**—Two seven-lb.-thrust retrojets have been added to the upper end of *Able-Star 9* to ensure clean separation from the payload.

No changes have been made to the *Able-Star* propulsion system other than installation of anti-sloshing baffles in the two propellant tanks. These were first used in *Able-Star 8 (Transit IV-A)* when previous launch data indicated a strong probability that propellant sloshing caused a dynamic coupling between the fluids and sensor elements of the guidance and autopilot systems.

Space-General estimates that the weight saved in *Able-Star 9* improvements closely equals the weight of the additional beacon, antennas, retrojets, guidance package and other new components. Cost of the changes is claimed to be less than the price of one *Able-Star* vehicle. ⌘

First Advent to Test Controls

FIRST LAUNCHING of *Advent* communication satellites with *Atlas-Agena* boosters will check out advanced attitude and orbit control systems.

A three-axis inertial-wheel system, backed up by stored-gas attitude jets, will keep transmitting and receiving antennas aimed at earth stations. Knowledge gained from a similar Space Technology Laboratories' attitude control system in *Orbiting Geophysical Observatory (OGO)* is being applied to *Advent* design.

As in *OGO*, *Advent's* two large solar paddles will be kept oriented to the sun by sensor devices on paddle shafts, although the main body will make one complete revolution, with respect to inertial space, in each orbit.

The cold-gas jets—fed from high-pressure storage containers—will be used only for attitude maneuvers beyond the capability of the inertial-wheel system. For long-duration operation of a controlled satellite in space, electrically driven inertial wheels appear to be the best devices. Although slow in accomplishing a rotational change, they operate relatively continuously for months without running out of power.

• **Initial objectives**—First *Advent* program phase will involve several low-altitude inclined satellite launchings. Objectives of this program will be to space-prove propulsion, attitude control, tracking, telemetry and command subsystems. STL, in providing systems engineering and technical analysis services, will also orbit control equipment, environmental sensors, and communications equipment.

Some of the equipment to be space-tested will be provided by General Electric, prime contractor for *Advent*. The full-scale research and development effort is the responsibility of the Army's *Advent* Management Agency (Ft. Monmouth, N.J.) under command of Brig. Gen. William A. Thames.

The *Advent* program will determine the feasibility of a multichannel microwave global space communication system for strengthening military communications. The system will place communications satellites in 24-hr. circular equatorial orbits to operate as radio relay repeater stations. Success of the *Advent* program depends upon reliable attitude control for antenna aiming, accurate orbit control to maintain exact position over a fixed point on earth regardless of perturbing forces, and dependable continuous operation of unattended microwave electronics in the space environment.

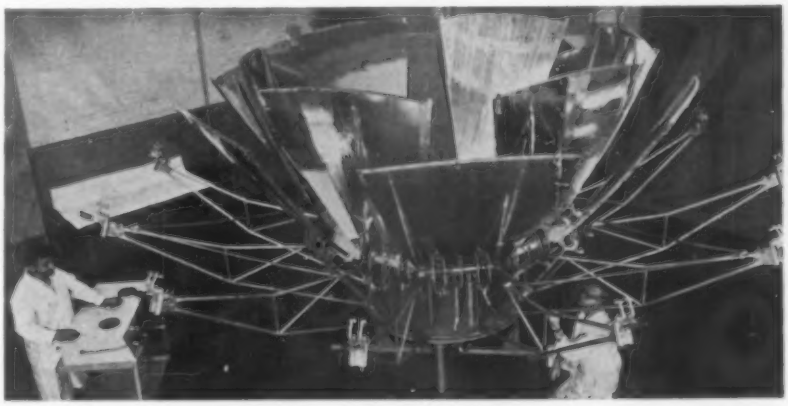
The last two vehicles in the NASA *Atlas-Centaur* development test program will be made available to place advanced *Advent* satellites in 24-hr. orbits.

• **Shifting emphasis** — The second phase of the *Advent* program stresses a different order of certain objectives and includes new areas of testing.

Principal objectives of the second phase will be to space-test attitude and orbit control, tracking telemetry, command, power, microwave communications, temperature control and environmental sensors.

To complete the *Advent* feasibility program, *Atlas-Centaur* vehicles will boost operational-type satellites into equatorial orbit at the fixed-position height of about 22,000 mi.

Construction of communication terminals is now under way at Camp Roberts, Calif., and Ft. Dix, N.J. A Navy ship will also provide a mobile receiving and transmitting station. ⌘



Collapsible Solar Mirror

PROTOTYPE petal-cut parabolic mirror developed by General Electric's MSVD for experimental solar thermionic power system unfolds to 16-ft. diameter. Equipment is going into GE's Phoenix, Ariz., solar test facility.

For early '62 firings . . .

Kwajalein's Zeus Test Facility Nears

Project Press construction at Roi Namur approaches half-way point; anti-ICBM missile to face wide range of targets

THE ARMY Corps of Engineers has completed some 70% of the $45 million to $50 million *Nike-Zeus* construction program on Kwajalein.

Meantime, nearly half of the $20-million construction program on near-by Roi-Namur for Project *Press* also has been completed.

All buildings for the huge *Nike-Zeus* test facility in the Western Pacific are expected to be placed under contract by October. All buildings for Project *Press* are expected to be under contract by next month.

Some 1150 construction workers are currently employed on the two projects. The monthly payroll is running between $450,000 and $475,000.

←

RECEIVER BUILDING is readied to house the huge Zeus Acquisition Radar (ZAR).

NERVE CENTER of the Zeus system is the missile battery control building, with towers for tracking radar antennas.

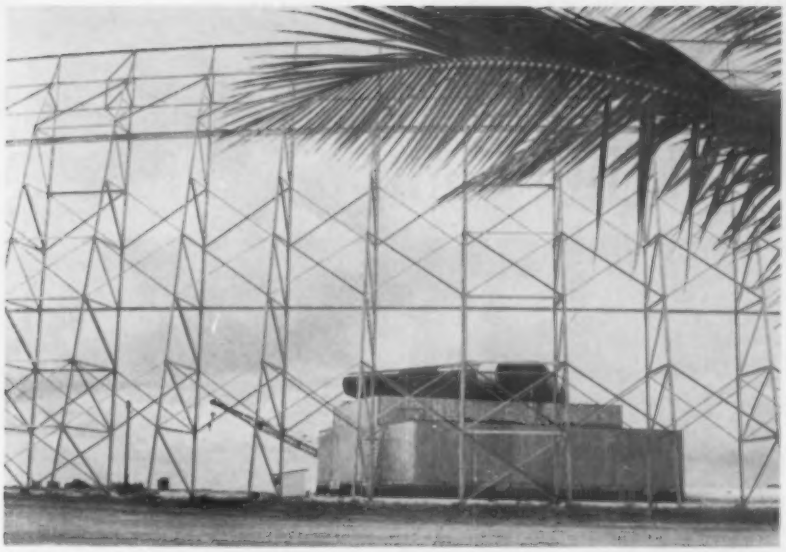
Completion

Most of the major installations for *Zeus* are already completed or nearing completion. The first tests of *Zeus* antimissile missiles against ICBM's launched from Vandenberg AFB are scheduled for early next year.

The tests at Kwajalein will check out the entire *Zeus* system for the first time. They will be used not only to prove the system but to bid for production money from the Kennedy Administration.

• **Varied targets**—In the tests, *Zeus* missiles will be launched against regular *Atlas* warheads and special warheads designed to present the *Zeus* system with decoys and multiple targets. *Zeus* missiles also are expected to be launched against electronic point-in-space targets.

Project *Press* — Pacific Range Electro-magnetic Signature Study—is a part of the *Project* Defender program which is aimed at seeking new means of combating incoming ICBM warheads. *Press* equipment will study ICBM launchings from the West Coast.



SIXTY-FIVE-FT.-HIGH shielding fence surrounds the Zeus Acquisition Radar Transmitter to protect personnel working in the area from its high power.

FRESH WATER for the vast Kwajalein complex is provided by 15 1-million-gallon fresh water tanks filled from a basin at the airstrip.

BOARDINGHOUSE for 300 civilians working on Project Press is a Navy APL Ship. Some 300 additional civilians eat aboard and sleep on shore.

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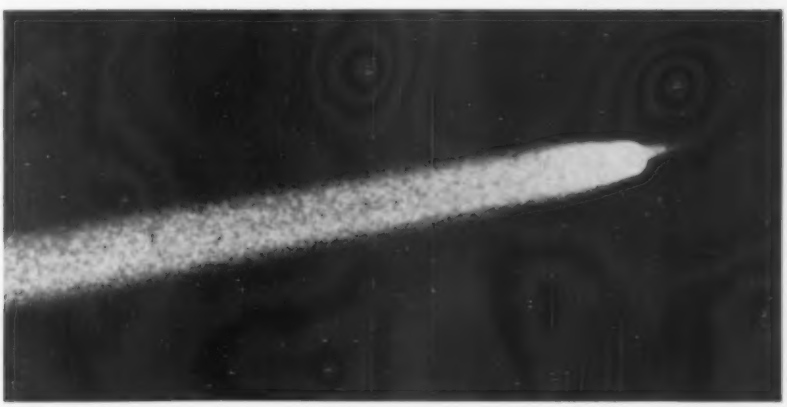
First photos . . .

In-Flight Minuteman Separation Sequence



HIGH-SPEED photo sequence caught this first-stage separation and second-stage ignition of the full-scale first *Minuteman* flight Feb. 11, 1961.

Taken while the three-stage ICBM was soaring about 45 miles into the sky, the top photo shows the moment of separation and ignition, with the first-stage engine still burning. In the next picture, the first stage has started to fall away; and in the third photo it is beginning to tumble while still in the exhaust path of the second stage. In the bottom photo, the second and third stages head downrange—where they also separated and ignited with similar precision.

Next shot of the 5500-mile solid-fueled missile—expected in a few weeks—will be the first from a silo at full range.

The photos in the sequence here were taken with a 70 mm ROti optical tracking camera using a 500-in. Perkin-Elmer lens.

Princeton Climate Spurs Research

Major Space Age R&D coming from campus where Goddard began serious rocket work; private labs thrive nearby

by Reed Bundy

PRINCETON, N.J.—"Almost a Utopia" is the way one rocket research professor describes it.

The quiet town of Princeton has been a leading academic community for more than 200 years. In this century, it became in addition a residential mecca for business and professional men with offices in New York and Philadelphia, both an hour's train ride away.

Now it has taken on a third dimension, as one of the nation's leading centers of missile/space research. Many millions of dollars have been invested by government and industry in basic and applied Space Age R&D at the university and more than a dozen industrial facilities in the immediate area.

At the university, research funded largely by the military services has produced much of the basic know-how of American propellant technology. It has also supplied invaluable knowledge of gas dynamics—including the only available performance data on speeds from Mach 15 to Mach 20.

Under the leadership of Dr. Martin Schwartzschild of Princeton, the first successful attempt to lift a telescope above the atmosphere by balloon—Project *Stratoscope I*—was carried out. Initial flights of *Stratoscope II*, carrying a telescope with a larger aperture, are scheduled for later this year, again under Schwartzschild's direction.

The ultraviolet-satellite study *Orbiting Astronomical Observatory No. 3* in the NASA program is being directed by Professor Lyman Spitzer, Jr., of the university's observatory (M/R, June 26, p. 26).

Spitzer also directs the Plasma Physics Laboratory (formerly Project *Matterhorn*), Princeton's major effort to achieve a controlled thermonuclear reaction, which is being pursued under a cost-reimbursed contract between the university and the Atomic Energy Commission. The 10-year-old program has cost $55 million so far.

The most spectacular Space Age contributions in the industrial community have come from the Radio Corporation of America. At its big laboratories in Princeton, RCA developed and produced the *Tiros* weather satellites. It will develop an experimental satellite for NASA's Project *Relay*. Earlier, it had a vital role in the *Score* and *Echo* programs.

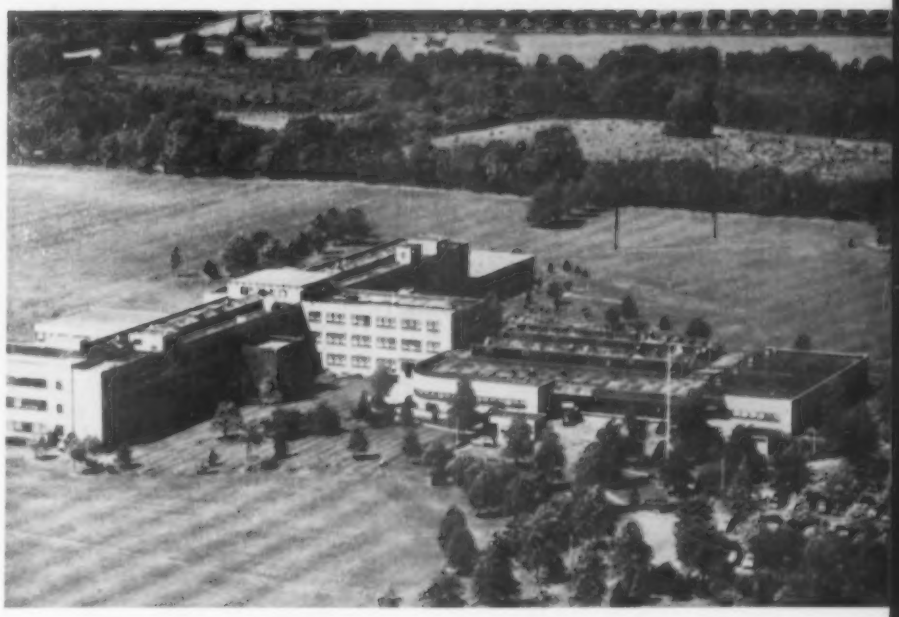
• **Goddard and Guggenheims**—All of this is especially appropriate because it was at the university in 1912 that Robert H. Goddard, during a one-year research fellowship, first began serious study of the possibilities of rockets. In a real sense, Princetonians feel that their town was the birthplace of America's Space Age.

There is another link between Princeton and Goddard. The Guggenheim family, which was Goddard's only substantial source of funds during his pioneering career, is also a financial mainstay of missile/space work at the university today.

Princeton recently announced that its Jet Propulsion Center will be expanded into The Daniel and Florence Guggenheim Laboratories for the Aerospace Propulsion Sciences. The next few months will see the beginning of construction of a new $300,000 laboratories building to broaden the work in jets, rockets, space flight and aerospace

LEFT: *Aerial view of Department of Aeronautical Engineering. Gas Dynamics Lab is in foreground (note helium bags).*

RIGHT: *Biggest industry facility in area is RCA's Sarnoff Center, now adding big space environmental center.*



propulsion which has been conducted at the Center since 1948.

The Center was one of the world's first institutions to offer graduate education and research in jet propulsion, rockets and astronautics. In the last 12 years, it has given graduate training to more than 200 specially qualified young scientists and engineers—of whom 56 were Guggenheim fellows. Many of these now hold key positions in U.S. missile/space programs. The Laboratories will now offer a minimum of four such fellowships annually.

Together with the Gas Dynamics Laboratory and the Applied Aeronautics Division, the Center forms the Department of Aeronautical Engineering. The Department is located next to the Plasma Physics Lab at the James Forrestal Research Center, on U.S. Route 1, east of the town.

• **Jet propulsion**—The faculty of the Jet Propulsion Center consists of the Robert H. Goddard Professor, Dr. Luigi Crocco; Professor Martin Summerfield; and Associate Professors Irwin Glassman and Jerry Gray.

Dr. Crocco is one of the world's foremost authorities on both jet propulsion and gas dynamics, and was a pioneer in the field, having worked on powder and liquid propellant rockets under the sponsorship of the Italian General Staff in 1928-30, while an undergraduate at the University of Rome.

He received a leave of absence from Rome in the fall of 1949, to accept an appointment as Visiting Professor at Princeton. He received a permanent Princeton appointment in 1953. Since his arrival in '49, he has occupied the Goddard Chair, established by the Guggenheim Foundation.

Crocco first published the results of his early work on problems of high-speed heat transfer in 1931. He then carried out an investigation of the possibilities of high-speed wind tunnels which contributed to the establishment in 1934 of the world-famous tunnel at the Guidonia Research Laboratory near Rome, one of the first ever built.

Later he worked with high-velocity aviation engines, aerodynamics, and after World War II as a consultant to the French War Ministry in the field of rocket propulsion.

His services as a consultant have been utilized in recent years by numerous U.S. corporations.

At the Jet Propulsion Center, Crocco has specialized mainly in liquid rocket combustion instability and related subjects and has, his colleagues say, "made it into a science."

The Center's chief expert on solid propellants is Dr. Martin Summerfield, who concentrates on such areas as steady-state burning ignition and parameters for programed control in flight.

Summerfield, who during World War II guided the development of a rocket engine for the X-1, first U.S. rocket plane, came to Princeton in 1949 as general editor of the university's pioneering publications program in high-speed aerodynamics and jet propulsion. He became a professor in the Department of Aeronautical Engineering in 1951.

Cluster of Industry

Most of the industrial labs in the Princeton area are involved in electronics. These include: *ASCOP Div. of Electro-Mechanical Research, Inc; DODCO, Inc.; General Devices, Inc.; Princeton Div., Curtiss-Wright Corp.; Princeton Computation Center, Electronic Associates, Inc.; Princeton Electronic Co.; and RCA's David Sarnoff Center and Astro-Electronics Div.*

Missile/space research in areas other than electronics is conducted at: *AeroChem Research Laboratories, Inc. (propulsion); Aeronautical Research Associates of Princeton, Inc. (aerodynamics); FMC's Research and Development Center (propulsion); G. F. Bush Associates (scientific instruments); and McLean Engineering Laboratories (cooling devices).*

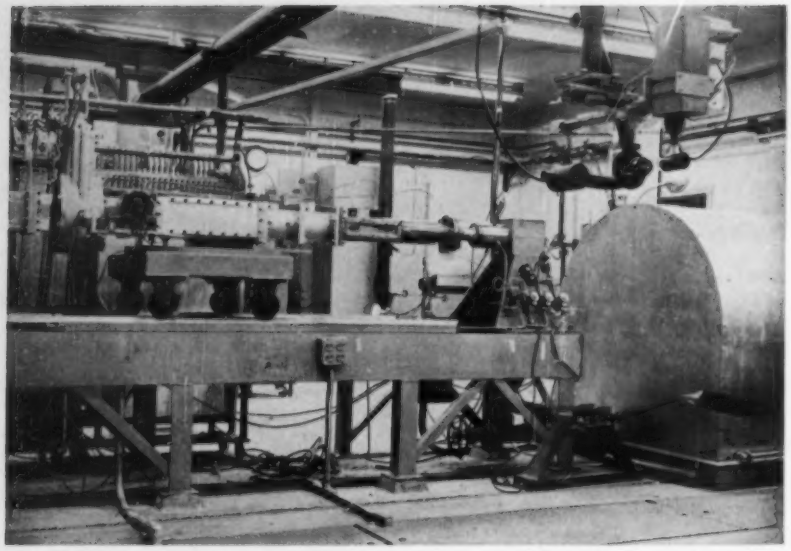
A number of Summerfield's research reports have pointed the way to new developments in rocket technology. In 1947 he coauthored (with Frank J. Malina) a paper on "The Problem of Escape from the Earth by Rocket," and a few years later he wrote a publication on "Problems of Launching an Earth Satellite," a technical evaluation of engineering aspects of satellite vehicles.

In recent years he has concentrated on the fundamental problems of solid-rocket propellant combustion and on flame propagation mechanisms in gases.

Summerfield was formerly technical director of Project *Squid*, a program of fundamental jet propulsion research at nine universities which had its headquarters at Princeton. He has served on government committees dealing with rockets, combustion and fuels, and has been a consultant to several major companies.

From 1945 to 1949, he was chief of the Rocket Research Division of the Jet Propulsion Laboratory at California Institute of Technology. Earlier, he was with Aerojet-General at Azusa, Calif., where from 1943 to 1945 he was Chief Engineer of the Special Project Department, directing research and experimentation in rocket development and production.

Summerfield is editor of the *ARS Journal* and for years was editor of *Jet Propulsion*, a now-defunct journal of the American Rocket Society. In 1954, he won the annual G. Edward Pendray Award for outstanding contributions to the literature of rocketry and jet propulsion. In 1960 he was elected to a third two-year term as a director of the ARS.



UNIQUE FEATURE of Gas Dynamics Laboratory at Princeton's Forrestal Research Center is helium hypersonic tunnel. Using helium instead of air for working fluid, it has been employed to test X-15 and other models at speeds up to Mach 20.

J. Preston Layton is program manager for Jet Propulsion. He negotiates the money contracts (which last year totalled about $800,000, including awards from all three military services and NASA), and controls expenditures.

• **Home-mixed solids** — "Our programs involve large sums, many people —and hazards," Layton says. "We make solids ourselves—solids with from 1000 to 2000 lbs. thrust—and students are exposed to them. There have been some explosions, but no casualties."

In each program, graduate students work with professors and research associates. "Nowhere else," Summerfield says, "is there this type of professor-researcher set-up. At (he named another well-known university with a jet propulsion laboratory) there is no faculty as such—work is financed by separate fees."

In Princeton's jet propulsion research program, by contrast, the work must originate at the Forrestal Center. Research results are published as theses, then must be suggested and accepted as the basis for further programs.

• **Gas Dynamics**—The university's unique Gas Dynamics Laboratory has three professors—Seymour M. Bogdonoff, Wallace D. Hayes and Sin-I Cheng—and an associate professor, S. H. Lam. The research manager is Indian-born Irwin Vas.

The 40-year-old Bogdonoff was responsible for developing the laboratory's facilities and has been in charge of its experimental program since it was begun with Navy backing in 1946. He has made pioneering contributions to supersonic and hypersonic aerodynamics, and is recognized as an expert in design and operation of subsonic and supersonic research apparatus. He is a frequent consultant to industry and the Air Force.

Bogdonoff came to Princeton's faculty after four years at the National Advisory Committee for Aeronautics (NACA) Laboratory at Langley Field, Va. During his years at Langley, he investigated in the Airflow Research Division, researched compressor blades, designed new cascade tunnels, and served for two years as assistant director of the Fluid and Gas Dynamics Analysis Section.

The Gas Dynamics Laboratory is the only one of its kind in the world equipped to simulate flight conditions at velocities ranging up to 20 times the speed of sound and at altitudes up to 150,000 ft.

The Lab, jointly sponsored by the Air Force and the university, is engaged solely in fundamental, non-classified research. Its continuing investigations in six high-speed wind tunnels have provided valuable test data on low supersonic speeds—and, the only available performance data on speeds from Mach 15 to Mach 20.

• **Helium tunnel**—These speeds are achieved in a hypersonic tunnel which uses helium rather than air as a working fluid. The technique was developed at the Lab some years ago. The helium tunnel can be run for as long as 10 minutes, compared to the milliseconds limit on other hypersonic tunnels.

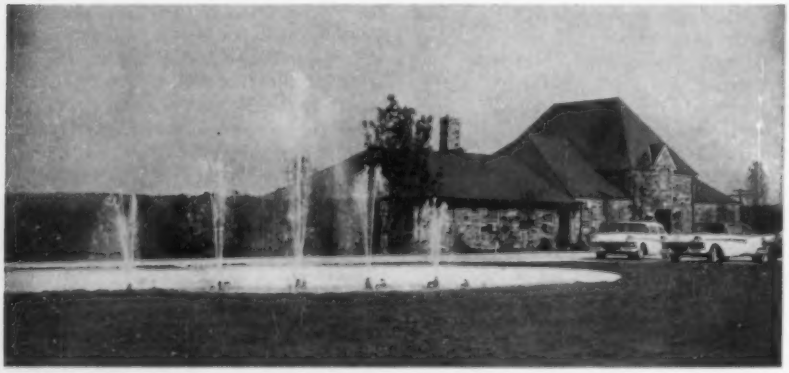
• **Theory mated to testing**—Bogdonoff calls the university's scientific atmosphere "close to Utopia." He points out that unlike other universities that "splinter up" their scientists, Princeton closely couples theory and testing. "We earn our living by not believing theories," he says. "We make experiments to check them out."

Although the laboratory's research capability is available to all, it has consistently refused to make a long-range connection with any company. Hence, while it has made spot tests from time to time, it is not a "testing outfit," in the professor's words. And the testing it has conducted has been keyed to national defense—no testing whatever for industry.

The money for the Gas Dynamics Laboratory's $300,000 annual budget comes largely from two longstanding Air Force contracts, one from the Office of Scientific Research and one from Wright Air Development Division.

"Most of the money goes to the students in one way or another," Bogdonoff says. "The budget pays for building everything we have to build. About two years ago, another $300,000 was set aside to develop facilities and build capabilities. The University added a new wing on the laboratory; the Air Force provided the equipment for it."

Despite the feeling that funding should be "once removed" from industry, the Laboratory has excellent con-



TYPICAL OF RELATIVELY SMALL industrial facilities in Princeton community is campus-like building housing Princeton Computation Center of Electronic Associates, Inc. Company performs computing services for many other firms.

nections with industry. One student who had been an engineer for five years was supported by The Boeing Company while he worked on his master's degree at the lab.

The group of graduate students includes, in addition to Americans, a broad range of foreign representation. Among past or present students are young men from Europe, South America, Japan and Formosa.

• **Industry top dog**—RCA has by far the largest industrial research operation in the Princeton area. Its laboratories at the David Sarnoff Center on Route 1 have some 1100 employees. At the Astro-Electronics Division, in nearby Hightstown, there are another 500. Between them they do a multi-million-dollar missile/space business annually.

In general, the laboratories work on "blue sky" projects, while AED is more nearly tied to earth. AED designed, developed and built the *Tiros* weather satellites, for which RCA is prime contractor to NASA. Other AED-supplied hardware includes FM receivers and transmitters used in Project *Score* and the beacon transmitters which are the only operating part of NASA's Project *Echo*.

RCA is a one-tenth owner of Industrial Reactor Laboratories in Plainsboro, about four miles from Princeton, and utilizes IRL nuclear reactor facilities in problems requiring use of radioactive materials.

The company is well along with construction of an elaborate advanced space environment center at Princeton.

RCA has worked with the University on both *Stratoscope* and the controlled fusion effort.

• **The lures**—There are obvious dollars-and-cents reasons why large and small companies have set up R&D facilities here and continue to do so. Princeton is, as noted previously, halfway between New York and Philadelphia. It is not far from many major manufacturing plants. And there is still land available.

For researchers, there are deeper advantages in the extracurricular activities centered around the university, with the full opportunity for exchange of ideas that this affords. One example is the Princeton Section of the American Rocket Society, one of ARS's most active groups.

A much-appreciated feature of the scientific life is Princeton's library book exchange program, in which the numerous industrial libraries have joined with the university. This makes Princeton's giant (1.4 million bound volumes) Firestone Library available to the company scientist, and gives him access to libraries at each of the other research labs. ⌗

soviet affairs

By Dr. Albert Parry

A "rocket-drill" for mining

is described by K. Kostin in a recent issue of *Tekhnika—Molodezhi*. It is called SBO—for *stanok burovogo ognia*, or "installation of drilling fire." Its action is aimed downward or sideways into the ore. "The working tool is a gas stream with a temperature of 2500 degrees of heat," the author explains. "The stream's power is so great that the installation holding the rocket-drill had to be made extra heavy—36.5 tons. Otherwise the stream could have carried the whole installation skyward."

Oxygen and kerosene constitute the rocket-drill's fuel; water is an important auxiliary. The gas stream breaks the ore; the water forms steam which throws the broken ore up to the surface of the mining pit. The rocket-drill is used on extra-hard ores. "The harder the ore, the better—faster—is its drilling," Kostin reports. The rocket-drill has been built by Giprorudmash Institute at Krivoi Rog in the Ukraine, famous for its high-grade iron deposits and mines.

A compass for a space ship

was discussed by M. Volgin and M. Karev in an article entitled "Superconductivity Knocks at the Doors of Technology" in the May issue of *Znanie-Sila*. An aircraft gyrocompass is useless in rocketry, they say, because "friction in bearings, from which the gyrocompass is suspended, can distort its function." Space flights over long distances demand a gyrocompass which is virtually frictionless and is not influenced by the rocket ship's sharp turns.

The authors suggest that "magnetic qualities of superconductors be utilized" for such a cosmic compass. "It is clear," they write, "that if a superconductor pushes the magnetic field out of itself, the magnetic field will push the superconductor out. And if we place the superconductor over a solenoid creating the magnetic field, the pushing force will at a certain moment balance the metal's weight. The superconductor will be suspended with no support.

"And now imagine a superconducting little ball suspended over a magnet and somehow or other made to revolve. Since there will be no bearings involved, there will be no friction. And if we dye the little ball and aim a ray of light at it, the reflected ray will make it easy for us to judge the direction of the axis of the ball's revolution." Hence the future space-ship compass, working perfectly.

The authors declare that, since the first models of superconducting gyroscopes have already been built and successfully tested, the next step would be to experiment with them on rocket ships.

The Sputniks have met with no meteoroids

"in all their flights of many millions of kilometers," remarks V. A. Sokolov of the staff of the Academy of Sciences in his article "Phases of the Great Path" in the May issue of *Nauka i Zhizn'*. "Possibility of a collision with a dangerous meteorite is extraordinarily small, although it is not absent entirely," Sokolov asserts. He foresees special precautions against such collisions for future space ships, traveling over great distances. These would include a division of the rocket's cabin into several compartments, each to be hermetically closed off from the others in such an emergency.

Little danger from meteoroids

threatens future astronauts, according to Boris A. Mirtov, a candidate of the physics-mathematical sciences, interviewed in the June issue of *Tekhnika-Molodezhi*. It is true that "nearly 5000 tons of meteorite precipitation falls to Earth every 24 hours, and all this mass bursts into the Earth's atmosphere with a gigantic speed." Granted that "an encounter with large meteorite particles can be fatal to a space ship, since [even] a particle of 6 to 8 millimeters in size can pierce a 10-centimeter aluminum plate. Yet, fortunately, particles of such sizes are rare. It has been established that a sphere 1.5 millimeters in diameter, at the height of 100 kilometers above the Earth, can bump into a cosmic particle 1 to 2 millimeters in size only once in a century."

Goddard's OSO

(Continued from page 23)

inches. In this way, the satellite's axial moment of inertia is made considerably larger than either of its transverse moments, and stability is enhanced.

The entire third stage is spun up to 100 rpm prior to third-stage firing. After third-stage burnout and payload separation, the wheel's spin rate is reduced to 30 rpm and held there by the action of gas jets attached to the spherical tanks of nitrogen.

The spinning structure is composed of nine wedge-shaped compartments. Five of these are for scientific experiments; the other four are used by Ball Brothers—the prime contractor for the *S-16*—to house some of the electronic controls, batteries, and all of the telemetry system, radio command system and in-flight data storage system.

The stabilized, or top, part of the satellite holds a fan-shaped array of silicon solar cells in addition to the pointing instruments. This entire structure is connected to the rotating base by an aluminum shaft that passes through the center of the rotating wheel. This shaft is held in position by two bearings, one at the top of the wheel and one at the bottom.

The stabilized section is servo-driven by gas jets to yield complete azimuth control and limited elevation control.

Solar Observatory Experiments

Prime contractor—Ball Brothers
High-Resolution Lyman-Alpha Spectrometer
University of Colorado

UV and X-Ray Spectrometer; Low-Energy Gamma Ray Monitor
Goddard Space Flight Center

Soft Gamma Ray Solar Monitor
University of Minnesota

Hard Gamma Ray Solar Monitor
University of Rochester

Materials Experiment
Ames Research Center

Neutron Flux Sensor; Electron-Proton Analyzer
University of California

The system's power requirement call for about 25.5 watts. During daylight operation, the solar cells will furnish 29 watts. Nickel-cadmium batteries will give power during solar eclipse.

Goddard scientists emphasize that the *OSO's* are part of a national program in which many universities and institutions will engage. In turn, the data gained will be freely given to anyone, of any nation, who can make use of it. It is felt that this is the way in which a major program of studying the sun can be most effective. ⌗

letters

(Continued from page 7)

us no end. Even though it's been years since we cracked our college physics text—because if we did we'd no longer understand it—we seem to recall that what you gain in kinetic energy, going downhill, you'd lose going up that same hill. In fact, you'd come out even ONLY if there were no friction, windage, and other losses.

Why then, in addition to the sloshing problem you referred to, would ski-launching of missiles serve any useful purpose?

Lucien R. Greif
Greif-Associates, Inc.
New York

Joint Switch

To the Editor:

I noted with interest the item titled "Fast Switch" in M/R's July 17 COUNTDOWN (reporting that four Dynatronics engineers cut a gear box out of an Eglin AFB antenna and flew it to San Nicolas Island off Point Mugu to fix a *Tiros* antenna, thus enabling NASA's *Tiros III* shot to be made with only one day's delay).

It appears that all the praise for this feat was heaped upon one organization when, in truth, it should have been spread around a little more.

Radiation Incorporated and Dynatronics were equally responsible for the quick-fix of the San Nicolas antenna.

Radiation engineers removed the gear box from the Eglin antenna, the Navy airlifted the box, and Dynatonics made the installation.

The Radiation engineers who performed this task take a special pride in the fact that they played a significant part in the success of *Tiros III*.

Louis P. Clark, Jr.
Director of Public Relations
Radiation Incorporated
Melbourne, Fla.

You're spreading it.—Ed.

PERT Enthusiasm

To the Editor:

Congratulations M/R! By giving incisive coverage to the Navy's PERT scheduling system, you have uncovered for your subscribers the hottest O.R. product in management today. PERT has revolutionized the control and direction of projects whose size and complexity staggers the imagination.

For the record, let me comment upon the function of PERT or, for that matter, of any management method devised by trained operations research analysts. Churchman, Ackoff and Arnoff in their classic work *Introduction to Operations Research*, define O.R. as "The application of scientic methods, techniques and tools to problems involving the operations of a system so as to provide those in control of the system with optimum soluitions to the problems." The emphasis here is clearly on the directive function of managers. Thus when M/R, July 17, asks the question in connection with PERT, "Will computers replace managers?", I must answer that, on the contrary, PERT, which involves extensive use of high-speed digital computation, will make managers not only as necessary as ever but *more effective by orders of magnitude*.

The O.R. approach is breathing new life into the management profession by supplying managers with accurate, up-to-date, and clearly stated data on the basis of which meaningful decisions may be made. The prevailing misconception of O.R. and its function is widespread indeed. For instance, in M/R's July 24 COUNTDOWN we read that the Czar of Project *Apollo* is destined to "overshadow NASA top command." This cannot happen. If *Apollo* is completely PERTized, the man in charge will not "run the show," as you put it, but as a manager with intelligence and a sense of responsibility, be charged with making decisions *based on his cognizance of incoming, first-level PERT data*. Swift implementation of these decisions may be assumed. Thus the decisions will never be arbitrary in any sense. They will be the result of a rational interpretation of accurate inputs describing not only the present status of the Project but its predicted status in the future.

The most important managerial function here is converting PERT feedback into optimized corrective action with maximum response time.

A careful look at the history of Project *Polaris* should dispel speculation by top echelon at NASA that the *Apollo* Czar will "steal the show." Vice Admiral Raborn, far from "overshadowing" the U.S. Navy, has, in directing *Polaris*, demonstrated conclusively that scientific management techniques applied to the utilization of American technological genius can accomplish the impossible—ahead of schedule!

Incidentally, the U.S. Government Printing Office has published a document by the Navy Special Projects Office describing PERT fundamentals. For those interested, twenty-five cents will get "PERT—Summary Report Phase I."

Lockheed Missile & Space Co.
Walter H. Trask
Sunnyvale, Calif.

Dyna-Soar's APS

To the Editor:

"DYNA-SOAR 'PICKS-OFF' *X-15* HARDWARE" (M/R, AUG. 7, P. 14) IMPLIES THAT THE ACCESSORY POWER SYSTEM TO BE USED IN THE *DYNA-SOAR* IS AN IMPROVED VERSION OF THE *X-15* HYDROGEN PEROXIDE UNIT. THIS IS INCORRECT. THE *X-15* APU IS A PRODUCT OF GENERAL ELECTRIC. THE *DYNA-SOAR* ACCESSORY POWER SYSTEM WILL BE DEVELOPED AND MANUFACTURED BY SUNDSTRAND AVIATION-DENVER, A DIVISION OF SUNDSTRAND CORP. THIS APS REPRESENTS A SIGNIFICANT ADVANCEMENT IN THE STATE OF THE ART IN APPLICATION OF HIGH-ENERGY TURBO MACHINERY.

R. Boyer, Jr.
Sundstrand Aviation
Denver

Reds Report 160 R&D Shots in '60

by Bernard Poirier

RUSSIA LAUNCHED MORE research rockets from surface ships in 1960 than from any individual land site. Of the total 160 launchings, 67 were from ships in the Pacific Ocean and five from a ship in the Black Sea.

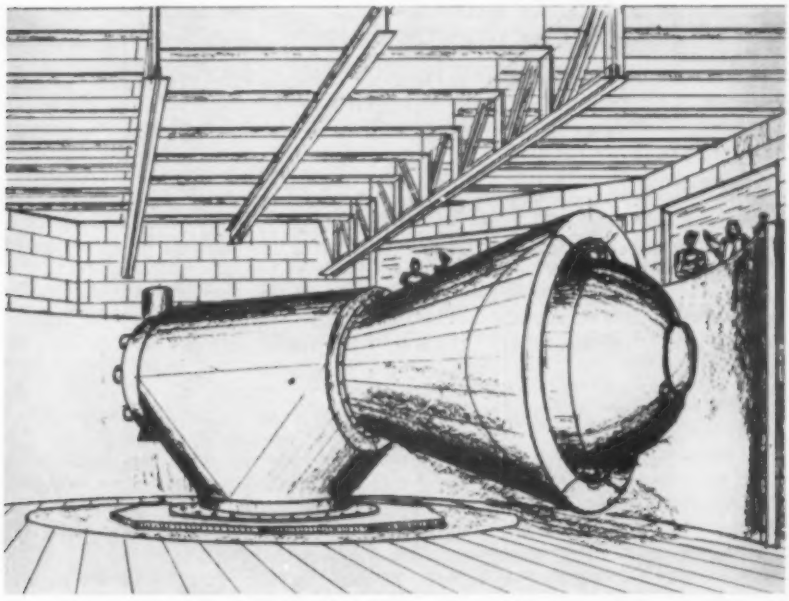
Details released last winter covering the first six months of 1960 listed only one vessel as the source of all Pacific experiments. However, the latest report for the remainder of the year said 40 additional rockets were fired "from special ships in the Pacific Ocean."

Of the land sites, the most active was in the Arctic—Heiss Island (Franz Josef Land). Through June, launchings there totaled 31. A decreasing effort of 23 through December accounts for a year's total of 54—considerably less than the number fired at sea.

In the published reports on the Soviet research shots, the only mention of radar tracking is in connection with the Black Sea series. In typical fashion, the first word of any shots from mobile sea bases came only when the Russians themselves announced them to the Secretariat of the Committee on Space Research in The Hague, Netherlands.

Soviet launchings of research rockets for period of July 1 to Dec. 31, 1960, as reported to COSPAR

MONTH	PLACE OF LAUNCHING			TOTAL
	HEISS ISLAND	EUROPEAN USSR	PACIFIC	
JULY	0	2	9	11
AUGUST	1	10	10	21
SEPTEMBER	6	3	0	9
OCTOBER	6	5	0	11
NOVEMBER	6	1	9	16
DECEMBER	4	3	12	19
TOTAL	23	24	40	87



Escape Trainer for Dyna-Soar Pilot

ACCELERATION FORCES likely to be encountered by crews of advanced vehicles such as the Dyna-Soar and B-70 will be duplicated for training purposes in a Dynamic Escape Simulator to be designed, developed and built by The Franklin Institute, of Philadelphia, under a $1.7-million contract from Aeronautical Systems Div. of the Air Force Systems Command. The Simulator, shown in an artists's conception, will apply pressures up to 20 g. It is slated to be operational by early 1963.

• **Limited data**—The new report differs from the earlier one in that it withholds coordinates of any launch site, names of vessels, actual dates and times of day the launches occurred.

The earlier report had made it possible to extrapolate Russia's program of increasing the number of probes just prior to an important event—for example, the firing on a new "super missile" into a South Pacific impact area early in the year.

On another occasion, the tempo of launchings was stepped up until 3 A.M. on the day *Sputnik IV* was orbited. The new report has cut off this source of information, and the most significant information remaining is the number of launchings in a month when a major event took place.

Sputnik V, for instance, was orbited and recovered in August. The chart shows that August was the most active months in the last half of the year, with 21 admitted launchings. December, when Russia failed to retrieve an orbited capsule, saw the second largest number of probes—19.

As reported in MISSILES AND ROCKETS (Dec. 19, 1960, p. 29), the coordinates for the Arctic launching site are 80° 37′ N, 58° 03′ E. Two expedition vessels were identified as mobile, seagoing launch sites—the Voyeikov in the Pacific, the Shokalsky in the Black Sea.

What originally was identified as the "medium latitudes" of European U.S.S.R. is now nebulized to "mean latitudes". Activity in this area rose from 10 launches in the first half of 1960 to 24 from July through December. ⌗

Boeing Presses Electronics

THE BOEING CO. has regrouped its Aero-Space Division and formed a new electronics design organization to "bring into sharper focus the Boeing Company's extensive activities in electronics."

The electronics packaging design section, under R. W. Lantz, is composed of design specialists in airborne and ground-based missile electronics. It will support design requirements for existing and proposed Boeing projects.

A new post of electronics manufacturing manager was assigned to R. H. Nelson, former manufacturing manager for Boeing's *Bomarc* program. His organization's responsibilities will cut across program lines to include all electronic and electrical manufacturing in the Aero-Space Div.

A Boeing spokesman said there are 21 separate electronics groups within the division, specializing in such areas as countermeasures, electronic environment, radar optical systems, infrared, communications, radio navigation, antenna development, semiconductor applications and electrical materials studies. He said the division has purposely kept its numerous electronic units small to "preserve flexibility and promote an effective work atmosphere."

JENSEN ENGINEERING, INC., has been formed in Palo Alto, Calif., to provide services and equipment in the field of satellite communication. Officers of the new organization are George M. Rouzee, President; John C. Keyes, Vice President.

DAYSTROM, INC. is transferring its Weston recorder controller and industrial gauge operations from Poughkeepsie, N.Y., to its Archbald, Pa., facilities. The shift is scheduled for completion by the end of September.

DYNATECH, INC. has been formed in Miami, Fla., to specialize in research and manufacture of advanced electronics devices. The firm's president, Dale Danielsen, said "we will concentrate heavily on the research and development of the relatively new RF modules."

SANDERS ASSOCIATES, INC. has opened an Advanced Communications Lab in Washington, D.C., to do R&D of sophisticated communications systems. Lawrence W. Sharpe has been named plant manager.

ATLANTIC RESEARCH CORP. has acquired through exchange of stock Flight Science Lab., Inc., Buffalo, N.Y. Flight Science will be operated as an Atlantic Research Corp. group. In addition to basic and applied research studies, FSL is engaged in the study and design of weapon systems.

MISSILE SYSTEMS CORP. has announced plans for construction of a $2-million computer center. MSC chairman, F. W. Bailey, said the new center continues the expansion program into the growing technical publishing and electronic data processing market.

B-I-F INDUSTRIES is now a division of The New York Air Brake Co. B-I-F is involved in automatic flow control, measurement, and weighing of gases, liquids and solids.

RYAN AERONAUTICAL CO. established a European office in Paris under the direction of retired French Air Force Lt. Col. Alain C. Jourdan. The company says the recent step-up in use of American military equipment in NATO countries has increased the market potential for electronic navigation sets and the Ryan *Firebee* target missiles.

BETHLEHEM CORP. acquired the assets of International Radiant Corp., New York City. IRC key personnel have joined Bethlehem's Environmental Engineering staff. The Division designs and manufactures environmental test equipment. Bethlehem Corp. recently changed its name from Bethlehem Foundry and Machine Company.

ELECTRO CUBE, INC., Pasadena, Calif., has been formed to specialize in design and manufacture of microminiature precision capacitors.

Financial Reports

COMPANY	PERIOD	INCOME		EARNINGS	
		1961	1960	1961	1960
Aero-Flow Dynamics, Inc.	6 Mo. June 30	$ 2,549,551	$ 2,653,393	$ −86,362	$ −74,143
Bourns, Inc.	6 Mo. June 30	6,921,888	5,332,584	445,489	341,410
Clevite Corp.	6 Mo. June 30	46,700,745	51,409,665	2,423,739	3,930,395
Dynalectron	6 Mo. June 30	17,245,034	16,531,797	201,968	−370,010
Electro-Instruments	Year, May 31	8,364,067	9,430,035	−381,752	706,708
Electronic Specialty Co.	6 Mo. June 30	12,728,223	5,068,008	477,118	12,529
Fairchild Stratos Corp.	6 Mo. June 30	39,742,000	45,549,000	1,639,000	−587,000
General Precision Equipment Corp.	6 Mo. June 30	118,903,557	120,722,804	2,488,704	2,369,183
Hoffman Electronics	6 Mo. June 30	31,336,996	23,935,550	349,657	123,054
Lear, Inc.	6 Mo. June 30	48,322,717	45,613,074	2,121,182	2,011,098
Lockheed Aircraft Corp.	6 Mo. June 30	679,163,000	657,077,000	9,223,000	−55,409,000
Loral Electronics	3 Mo. June 30	9,606,000	9,084,000	350,000	310,000
Marquardt Corp.	28 Wks. July 14	24,690,485	36,318,093	356,461	599,597
McCormick Selph	Year April 30	1,900,000	1,500,000	52,971	53,387
North American Aviation	9 Mo. June 30	893,128,162	717,445,130	18,539,000	16,526,000
Texas Instruments	6 Mo. June 30	119,860,000	116,051,000	6,374,000	7,921,000
	3 Mo. June 30	60,883,000	59,853,000	2,601,000	3,991,000
Thiokol Chemical Corp.	6 Mo. June 30	84,996,405	83,361,675	2,242,755	1,736,648
Tool Research and Engineering Corp.	9 Mo. April 30	10,597,167	2,610,596	445,515	164,207
United Electro-Dynamics	6 Mo. June 30	5,398,534	3,954,227	61,527	209,194
Varian Associates	39 Wks. July 1	42,296,488	34,392,995	2,351,813	2,180,255
Westinghouse Electric Corp.	6 Mo. June 30	920,381,000	953,844,000	19,561,000	40,454,000
Zero Manufacturing Co.	3 Mo. June 30	1,815,221	1,492,782	77,521	60,757

missiles and rockets
4th Annual

ground support equipment issue

Articles in the 4th Annual **GSE** Issue will examine developments, problems and requirements of the missile/space support equipment market from 1961 to 1971.
M/R will probe, in detail, the headaches on the horizon:

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- Pro & Con—Are missile **GSE** standardization efforts a failure?
- Once the **ICBM** bases are built, what will happen to the **GSE** market?

Plan now to capitalize on the intense readership this issue will generate among **M/R**'s 32,500 * subscribers —who will read and re-read, think about, and analyze this unique issue.

Issue Date—September 18, 1961
Advertising Closing Date—August 28, 1961

*** Subject to audit.**

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contracts

AIR FORCE

$8,000,000—**Bendix Systems Div.**, Ann Arbor, Mich., from Electronic Systems Div., Hanscom Field, Mass., for work on a rocket-borne communications system.

$7,078,060—**North American Aviation, Inc.**, Los Angeles, for design and development of guided missiles and trainer kits for use with F-100 aircraft.

$3,685,279—**Laboratory for Electronics, Inc.**, Boston, for components of the AN/APN-131 radar set and data.

$1,577,102—**Hughes Aircraft Co.**, for production of shipping and storage cases for missiles.

$1,250,000—**The Martin Co.**, Baltimore, for repair, modification, technical order compliance, test, preventive maintenance and reclamation of *TM76B* missile weapon system components and related equipment.

$1,133,000—**General Electric Co.**, Philadelphia, for research and development of *Samos II* program.

$1,014,548—**The Martin Co.**, Baltimore, for maintenance of *Matador* and *Mace* missile systems.

$1,100,000—**Astro-Science Corp.**, for follow-on for Dew Line mobile ground support systems and pod-handling systems for the B-58, plus spares.

$762,927—**General Electric Co.**, Defense Electronics Div., Utica, N.Y., for components of countermeasures receiving set, AN/ALR-18; spare components and parts, aerospace ground equipment, mobile training unit and data.

$629,612—Goodyear Aircraft Corp., Akron, Ohio, for services and supplies required for repair, calibration, test, overhaul and preventive maintenance of *Mace* map synthesis equipment.

$600,000—**Radiation, Incorporated**, Melbourne, Fla., for design of ground antenna system for *Dyna-Soar* glider program.

$395,209—**Goodyear Aircraft Corp.**, Akron, Ohio, for storage and distribution of *Mace* aerospace ground equipment, AN/DPQ-4 nose sections, XD coded spares and components, and XB coded spares to support the GAC-DM facility.

$300,000—**Systems Div., Daniel, Mann, Johnson, & Mendenhall**, Los Angeles, from Edwards AFB Flight Test Center, for preliminary design for a toxic-propellant rocket propulsion test system; feasibility studies and designs of future prototype and unique rocket test systems; and operations research study of design criteria for missile static-test facilities. (3 contracts).

$285,000—**General Precision, Inc., GPL Div.**, Pleasantville, N.Y., from Aeronautical Systems Div., Dayton, for research and development for a nuclear gyroscope which would use the nucleus of the atom as a reference.

$270,000—**Houston Fearless Corp.'s Westwood Division**, for design and manufacture of an electronically controlled random access photographic storage and retrieval system for Rome Air Development Center.

$175,000—**Gilliland Instrument Co., Inc.**, Oakland, Calif., from Missile Test Center, Cape Canaveral, for production of a device for "reading" films of missiles in flight.

The Marquardt Corp., Pomona, Calif., from Aeronautical Systems Division, for prototype radar simulator which will simulate radar scanning by means of a light optical scanning principle. No amount disclosed.

MISCELLANEOUS

$6,300,000—**Aerojet-General Corp.**, Azusa, Calif., from NASA and AEC, for preliminary work on an atomic engine. **Westinghouse Electric Corp.**, will be subcontractor for nuclear portions of the work.

Wiley Electronics Co., Phoenix, Ariz., from **Ford Motor Co.'s Aeronutronic Div.**, for production of altimeter for *Ranger* spacecraft lunar capsule. No amount disclosed.

NAVY

$7,500,000—**Electric Storage Battery Co.**, Philadelphia, for submarine batteries.

$1,178,955.—**United Electrodynamics, Inc.**, Los Angeles, from BuWeps, for transitorized airborne telemetry systems for converting obsolete jet fighters into target drones.

$1,158,000—**FMC**, San Jose, Calif., for a prototype of amphibious support vessel with retractable hydrofoils.

$1,040,782—**Mid-Indiana Mfg. Corp.**, Indianapolis, for *Zuni* rocket launcher.

Ryan Aeronautical Co., San Diego, from BuWeps, for logistic support of *Q-2C Firebee* jet drone operational program. No amount disclosed.

ARMY

$1,442,520—**Acme Missile & Construction Corp.**, Rockville Centre, N.Y., for construction of *Polaris* Class 9 facilities, Cape Canaveral Missile Test Annex.

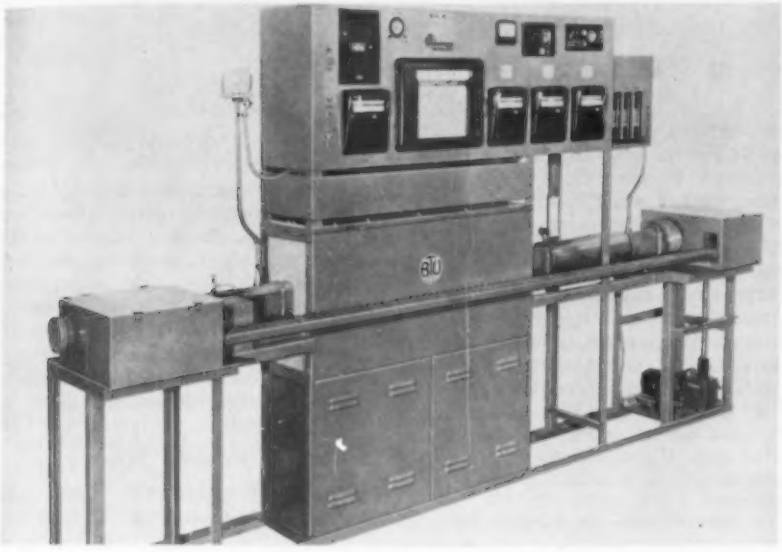
$328,433—**General Atronics Corp.**, Bala-Cynwyd, Pa., for design, development and testing of new communications system (Kathryn).

$325,000—**Radioplane, Div. of Northrop Corp.**, Van Nuys, Calif., for 2 sets test equipment for AN/USD-1 surveillance drone system.

$300,000—**Bendix Systems Division**, Ann Arbor, Mich., from Signal Supply Agency, Philadelphia, for modification of *Advent* communications satellite system.

$156,923—**Granger Associates**, Palo Alto, Calif., for ionospheric sounding equipment.

Temco Electronics and Missiles Co., subsidiary of Ling-Temco Electronics, Inc., Dallas, for manufacture of the afterbody of the atomic projectile for *Davy Crockett* weapon system. No amount disclosed.



Furnace Eliminates Manual Soldering

Fluxless soldering production methods which eliminate manual soldering and produce uniform results at lower cost are available with a horizontal Transheat soldering furnace developed by BTU Engineering Corp., Waltham, Mass.

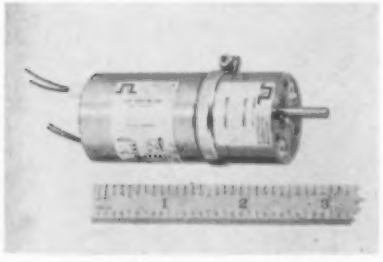
Designated the TSH, the new furnace has provisions for single-station loading and unloading, unlike a belt-type furnace which requires operators at both ends. It has a continuous, horizontal, closed-loop chain drive with boats onto which parts, or preloaded fixtures are placed. The fixtures, holding component elements and solder preforms, move into the furnace, where soldering is accomplished under carefully controlled temperature and atmosphere, and return to the same front station at which they were originally loaded. The length of the conveyor can be made to accommodate any desired number of operator stations.

Temperature profiles of the product can be controlled to ±1°C. The furnace is rated to 600°C. Closely controlled hydrogen atmosphere within the furnace eliminates the need for handling flux, and produces a clean, oxide free bond with good wetting characteristics.

Circle No. 225 on Subscriber Service Card

Step Servo Drive

A 1/10 revolution (36°) step-servo drive for digital system application is being introduced by Automation Development. Since the output shaft rotates bi-directionally 36° or 0.1 revolutions per each input pulse, this drive can be directly coupled to digit wheels and counters and other digital control equipment. The drive utilizes precision ball bearings and consists of an ADC standard step-servo motor in combination with an integrally mounted in-line gear head. This drive, when operated in conjunction with ADC's standard step-servo controllers and pulse sources can achieve instantaneous reversal at speeds up to 200 pulses per second.



Circle No. 226 on Subscriber Service Card

Temperature Chamber

Delta Design, Inc. has added a large volume-low gradient model to their line of temperature chambers. The Model 1060B chamber has temperature profile characteristics suitable for Mil-Spec testing of large assemblies where temperature variation throughout the specimen, including gradient, control variations, and drift is not to exceed ±1°C. The large test volume, approximately six cubic feet, permits evaluation of fairly large specimens.

Circle No. 227 on Subscriber Service Card

Electronic Level Check

An Electronic Level, a new type of precision instrument in which the standard bubble is replaced by a pendulum and a pair of variable-inductance transducers which provide an electrical displacement signal, is available from Engis Equipment Co. This signal is amplified to feed a center-zero meter. The Talyvel is battery-operated. The transistorized amplifier and meter is scaled in angular measure as well as linear, to indicate precisely the amount of tilt of the Talyvel unit. The pointer comes to rest in about one second.

Circle No. 228 on Subscriber Service Card

Noiseless Transducers

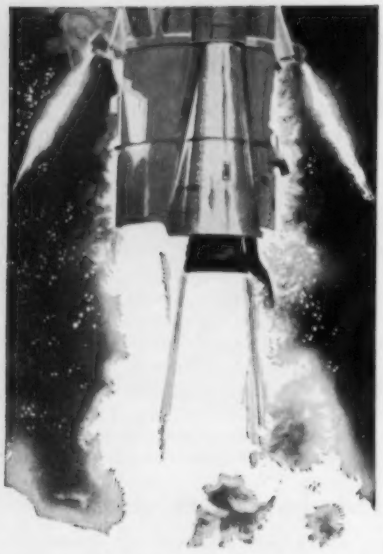
A variable piezoelectric transducer whose mount eliminates more than 85% of the noise produced by more conventional transducers has been made available for military and laboratory environmental testing applications by the Mirax Chemical Products Corp. The Variducer can be used to measure shock velocity, blast pressure, compression and expansion wave durations, force, and other parameters. Designed to meet any pressure in the transducer field, the unit will also withstand temperatures up to 300°C.

Circle No. 229 on Subscriber Service Card

High Gain Amplifier

A high gain amplifier which combines high common mode rejection with 5 mv/cm sensitivity and low drift

is available from Hewlett-Packard Co. The amplifier, Model 162D, is a plug-in unit designed for the Hewlett-Packard Model 160B and 170A oscilloscopes. The Model 162D has 12 calibrated ranges 5 mv/cm to 20 volts/cm, with a vernier providing continuous adjustment between ranges and extending minimum sensitivity to at least 50 volts/cm. At maximum sensitivity,



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Reinforced plastics make it possible to design parts that will withstand 10,000°F. At heats where other materials fail suddenly, reinforced plastics ablate uniformly.

R/M asbestos-phenolic parts are used on virtually every U.S. missile. They exhibit a highly desirable combination of properties such as low thermal conductivity and diffusivity, low rate of ablation, high strength-to-weight ratio, excellent shock resistance and structural integrity.

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Tape wound rocket motor tube liner of R/M Style 41RPD Pyrotex.®

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Reinforced Plastics Department, Manheim, Pa.

SPECIALISTS IN ASBESTOS, RUBBER, ENGINEERED PLASTICS, SINTERED METAL

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the 162D/170A combination has a rise time of less than 10 nanoseconds; the 162D/160B combination has a rise time of less than 29 nanoseconds.

Circle No. 230 on Subscriber Service Card

Giant Vacuum Pump

The addition of a 32-in.-diameter oil-diffusion vacuum pump to its PMC pump line has been announced by Consolidated Vacuum Corp. This pump, designated Type PMC-50000, is the largest of its kind in the high-vacuum field and was developed specifically for the fast, clear evacuation of the very large space chambers used in space simulation studies. It consistently provides a plateau speed, hitherto unknown to any high vacuum pump, of 52,000 liters per second throughout the 3 x 10^{-5} to 4 x 10^{-4} mm Hg pressure range. It has a baffled ultimate pressure of 2 x 10^{-9} mm Hg and a very low backstreaming rate of only 0.194 mg/cm²/hr.

Circle No. 231 on Subscriber Service Card

Serial Type Memory Device

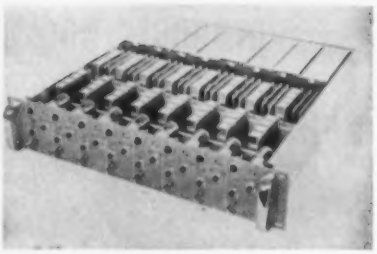
Utilizing a quartz delay line, a device storing 65 bits of information at a 10 megacycle counting rate with an access time of less than 4 micro-seconds is available from Anderson Laboratories Inc. It may replace other components

now used in digital computers which are substantially larger in size and cost. In this application this is the first time that a high speed, short delay package has been achieved. This unit operates at a counting speed over ten times greater than was heretofore practical with acoustic delay lines.

Circle No. 232 on Subscriber Service Card

Signal Conditioner

Astra Technical Instrument Corp. has available a line of strain-gage signal conditioning equipment of which the SSC-1 is the initial production model. This eight-channel, rack-mounted unit offers these advantages: any configuration of bridge circuitry (1-, 2-, 3-, or 4-active arms); up to four calibration



points; single and double shunt; plus or minus and plus and minus calibration, all merely by changing plug-in cards without rewiring. Each channel consists of an isolated, highly regulated power supply; precision calibration circuitry; connections that provide missing segments of a full bridge; and circuitry for remote or local calibration and control.

Circle No. 233 on Subscriber Service Card

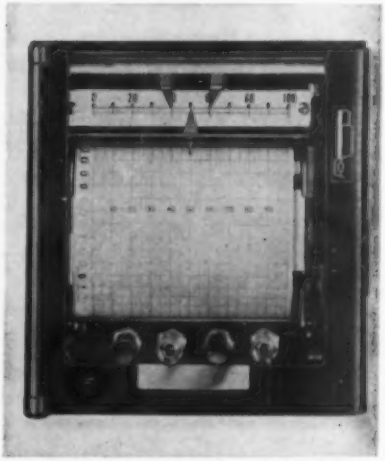
Welding Power Source

Simplified controls for both gas-shielded arc and submerged arc welding is a feature of an RCP Industrial d-c arc welder, for semiautomatic and automatic operation, from Westinghouse Electronics Corp. Now available, this selenium-rectifier, 500-600 amp power source is designed to meet the demands for the majority of arc-welding processes in the metal-working industry. It provides the relatively flat voltampere characteristics required for maximum arc stability for both automatic and semiautomatic welding. This insures instant arc starting and recovery, reduced burn back and stubbing.

Circle No. 234 on Subscriber Service Card

4-inch Telemeter Receiver

A line of 4-inch chart width telemeter receivers (Series 670) is available from the Bristol Co. Designed to fit any Metameter telemetering system, the instruments are offered with one or two pens. Each pen is available with one or



two retransmitting slidewires, and a maximum of four individually adjustable alarm contacts. Each alarm contact has an individual scale. Two of the maximum eight alarm contacts can be set from the front.

Circle No. 235 on Subscriber Service Card

Resistance Transducer

Winsco Instruments & Controls Co. introduced Model 2508, a high temperature, surface, resistance-temperature transducer. Using a platinum element, this ultra-thin rectangular transducer provides continuous operation at temperatures as high as 2000°F. Winsco's special high temperature cement is the preferred method for installing the Model 2508 on a surface where temperature is to be measured. This cement cures by air-drying at room temperature and maintains its bond strength beyond 2000°F. Installation by welding is also possible.

Circle No. 236 on Subscriber Service Card

Magnetic-Tape Certifier

An automatic system for detecting defects in magnetic tapes has been developed by Cybetronics, Inc. This system, the Model C Magnetic Tape Certifier, can be used with any tape transport at its normal speed and packing density. All channels are inspected simultaneously in a simple, push-button-controlled operation. After the "start" button is pushed, the tape moves until a drop-out occurs. The tape can then be checked within the inspection area provided in the transport and can be advanced or rejected, depending on the nature of the defect that caused the drop-out.

Circle No. 237 on Subscriber Service Card

3000 PSI Lo-Torq Valve

A 3000 psi series 8600 Lo-torq Selector Valve in the price range of spool valves is the latest offering of the Republic Manufacturing Co. This line, while in the spool valve price range, offers many advantages over the spool type. There is no internal leakage in indexed positions, and little during port selection. The pressure balanced valving disk makes turning easy. Maximum working pressures are 3000 psi for oil service, and 2000 psi for lubricated air service.

Circle No. 238 on Subscriber Service Card

D-C Corona Tester

A new corona test set with 20 kv corona-free d-c high voltage supply, corona pickup filter network and corona detector is available from Associated Research, Inc. The Model 5435 D-C Corona Test Set detects corona discharge and displays the voltage pattern on a built-in oscilloscope having special characteristics. The vacuum bell-jar and table mounted at the top of the cabinet are evacuated by an internally mounted vacuum pump.

Circle No. 239 on Subscriber Service Card

Microwave Phase Shifter

E & M Laboratories has developed a phase shifter which provides a considerable amount of phase shift over an extended bandwidth. This unit covers the 8.5 to 10.2 kmc/s region, providing in excess of 600° phase shift above 9.8 kmc/s. The drive requirement for this unit is 800 ma of d-c current, which can be modified for other current levels and for a-c modulation. The length of 7¾ inches, bandwidth, center frequency, and phase shift can be varied.

Circle No. 240 on Subscriber Service Card

MODELS 2410 and 2411

RUSKA DIFFERENTIAL PRESSURE INDICATOR

Sensitivity: .0002 psi/scale division. Maximum operating pressure: 15,000 psi. Maximum overpressure: 15,000 psi.

Ruska engineers have designed a new differential pressure indicator that is highly sensitive to a differential pressure and is also capable of withstanding high overpressures.

The electronic circuitry incorporates conservatively operated components and semi-conductors for small size and high reliability.

The unit is simple in design, rugged, and easy to adjust and operate. A most convenient feature of the unit is the meter readout which is a function of the differential pressure. Full scale on the meter readout denotes a differential of 0.05 psi (Model 2410) or 0.005 psi (Model 2411), each scale division denoting approximately 0.002 psi (Model 2410) or 0.0002 psi (Model 2411).

For complete information, call or write:

RUSKA INSTRUMENT CORPORATION

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Circle No. 13 on Subscriber Service Card

names in the news

NUSSDORFER

BURNS

MORTENSON

KIRSCH

TOBIN

Leo A. Carter: Former vice president-general manager, Douglas Aircraft Co., Santa Monica, and 30-year Douglas veteran, named assistant for management evaluation to vice president and space systems divisions general manager, Lockheed Missiles and Space Co., Sunnyvale, Calif.

Fred A. Payne, Jr.: Former manager of advanced systems planning, North American Aviation, Inc., appointed assistant director of defense research and engineering for strategic weapons. Payne succeeds **Dr. Marvin Stern,** who was named DOD's deputy director of weapons systems in June.

Theodore J. Nussdorfer: Named manager of aerospace systems research, Geophysics Corporation of America, Bedford, Mass. Nussdorfer formerly was a group leader in evaluation of ballistic missile defense systems for Arthur D. Little, Inc.

Roswell P. Barnes: Appointed head of Melpar's Applied Science Division Physics Laboratory, Watertown, Mass.

Dan W. Burns: Appointed vice president in charge of defense activities for The Siegler Corp., Los Angeles. **Walter J. Kruel** succeeds Burns as president of Siegler's Hufford Division, El Segundo.

Dr. Arnold T. Nordsieck: University of Illinois physics professor since 1947, appointed to head Technical Specialties Dept., General Motors Defense Systems Divisions, Santa Barbara, Calif.

Francis J. Dunleavy: Named general manager, Communications and Controls Division, Radio Corporation of America. Dunleavy formerly was general manager, industrial controls.

Jack S. Parker: Appointed vice president and group executive in charge of Electronic and Flight Systems group, General Electric Co.; **Robert E. Pfenning** named comptroller; **Virgil B. Day** named vice president in charge of relations services.

Dr. Artur Mager: Appointed assistant director of spacecraft sciences, Aerospace Corp., Los Angeles. Before joining Aerospace Corp., Dr. Mager was director of sciences, National Engineering and Science Co., Pasadena.

Fredric M. Cooper: Former director of engineering, appointed vice president and general manager of Amcel Propulsion, Inc., Asheville, N. C.

Ivan E. Walenta: Appointed chief of space instrument systems section, Jet Propulsion Laboratory, Calif. Institute of Technology, Pasadena. **Herbert G. Trostle** promoted to assistant section chief of research analysis. Both sections are in the Space Sciences Division.

Richard K. Mosher: Promoted to vice president in charge of Systems Division, LFE Electronics, a major operating group of Laboratory for Electronics, Inc., Boston.

William D. McBride: Appointed director of information services, The Martin Co.'s Denver division, succeeding **Don P. Herron,** who joins the corporate staff as director of information programs at Martin's headquarters, Friendship International Airport, Md.

Lawrence H. Dworetzky: Appointed associate director, Advanced Systems Planning, General Precision, Inc., Tarrytown, N.Y. Dworetzky formerly was head of advanced systems development of AC Spark Plug's Wakefield research laboratory.

Lee N. Mortenson: Named manager, research and analysis department, Wyle Laboratories, El Segundo. Mortenson will continue as program manager, Air Force Ballistic Systems Division Program at Wyle.

J. P. Field: Promoted to director of programs, Bendix Corp.'s Mishawaka Division in Indiana. Reporting to Field will be **E. F. Lapham** as *Typhon* program manager, **T. S. Torian** as *Talos* program manager. **J. A. Reed** appointed contracts manager, with **D. A. Tuttle** as estimating manager.

Alfred C. Evans: Named director of research and development, Weston Instruments Division, Daystrom, Inc., Newark, N.J. **George V. Gerber** appointed chief components engineer in the Military Electronics Division in Archbald, Pa.

Joseph E. O'Hara, Jr.: Appointed vice president, Datatrol Corp., Silver Spring, Md. Previously O'Hara was a systems analyst for Department of Defense.

Donald D. Kirsch: Appointed manager of aerospace electronics marketing department, Waltham Laboratories of Sylvania Electronic Systems, a division of Sylvania Electric Products, Inc. **Arne Schleimann-Jensen** named manager of product engineering for Microwave Device Operations plant of Sylvania, Mountain View, Calif.

Dr. Edward G. Witting: Appointed manager of research and new products, Cannon Electric Co., Los Angeles. Dr. Witting leaves the post of Deputy Assistant Secretary of Army (R&D) to assume the new research position.

Dr. Wernher von Braun: Director of the National Aeronautics and Space Administration's George C. Marshall Space Flight Center, Huntsville, Ala., named Honorary Space Chairman of the 1962 Seattle World's Fair.

Dr. John N. Dempsey: Named director of Minneapolis-Honeywell's Research Center and associate director of the company's over-all research activities. Dr. Dempsey succeeds **Dr. Van W. Bearinger,** appointed general manager of Honeywell's Semiconductor Division.

William H. Enders: Appointed manager, Advanced System Projects, RCA's Aerospace Communications and Controls Div., Defense Electronic Products, Burlington, Mass. Enders formerly was administrator, market research and analysis, for the same division.

LaVerne J. Tobin: Named vice president-sales and a member of the board of directors, American Orbitronics Corp., Washington, D.C.

Eugene Fioramonti: Elected vice president, Powertron Pacific Corp., Los Angeles, a subsidiary of Powertron Ultrasonics Corp.

Dr. R. E. Henning: Promoted from engineering manager to chief engineer, Sperry Microwave Electronics Co., Clearwater, Fla.

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Electronics Engineers Wanted for M/R Editorial Positions

Wanted: Electronics engineers now working in missile/space industry with experience in writing for publication. Fulltime positions open in Missiles and Rockets editorial offices in New York and California. News background desirable. Send resume, including current salary.

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Wash. 5, D.C.

—when and where—

AUGUST

National Academy of Sciences 10th Pacific Science Congress, University of Hawaii, Honolulu, Aug. 21-Sept. 8.

American Rocket Society Fourth Biennial Gas Dynamics Symposium, cosponsored with Northwestern University Technological Institute, Evanston, Ill., Aug. 23-25.

American Institute of Electrical Engineers, Pacific General Meeting, Salt Lake City, Aug. 23-25.

AFOSR Sixth International Conference on Coordination Chemistry, sponsored with American Chemical Society, Wayne State University, Detroit, Aug. 27-Sept. 1.

American Society of Mechanical Engineers 1961 West Coast Conference of Applied Mechanics, University of Washington, Seattle, Aug. 28-30.

ASME and AIChE International Heat Transfer Conference, New Developments in Theory and Practice, University of Colorado, Boulder, Aug. 28-Sept. 1.

Third International Symposium on Rockets and Astronautics, Japanese Rocket Society, Tokyo, Aug. 28-Sept. 1.

Second Annual Bionics Symposium, sponsored by General Electric Co. and Cornell University, GE Advanced Electronics Center, Ithaca, N.Y., Aug. 30-Sept. 1.

SEPTEMBER

Army Aviation Association of America Annual Meeting, Sheraton-Park Hotel, Washington, D. C., Sept. 3-5.

Farnborough Exhibition, England, Sept. 4-10.

Eighth Anglo-American Aeronautical Conference, Royal Aeronautical Society and Institute of the Aerospace Sciences, London, Sept. 4-14.

National Conference Institute of Engineering Inspection and Society of Non-Destructive Examination, Oxford, England, Sept. 5-8.

Joint Nuclear Instrumentation Symposium, sponsored by IRE's professional groups on Nuclear Science and Instrumentation, AIEE, ISA, and others, North Carolina State College, Raleigh, Sept. 6-8.

National Symposium on Space Electronics and Telemetry, IRE, University of New Mexico, Albuquerque, Sept. 6-8.

National Conference, Association for Computing Machinery, Statler-Hilton Hotel, Los Angeles, Sept. 6-8.

1961 New Product Exhibit and Conference, Los Angeles Chamber of Commerce, Ambassador Hotel, Sept. 7-8.

1961 Fall Meeting of The Combustion Institute, Western States Section, University of California, Berkeley, Sept. 7-8.

National Aeronautic Association 1961 National Convention, Westbury, L. I., N. Y., Sept. 10-13.

NEW, SENSITIVE HELIUM LEAK DETECTOR

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editorial . . .

Where the Money Ain't

RESEARCH AND ENGINEERING funds took the largest blow when Congress cut $112 million from the National Aeronautics and Space Administration budget. Some $73 million in R&E money was axed.

Technically, NASA now is in the process of deciding which programs to cut back as a result. In fact, the situation is not as serious as it might appear. NASA is likely to keep its programs going and, as it did last year in a similar situation, ask Congress in January for a supplemental appropriation to make up the deficit.

Just what the benefit of this financial hocus-pocus might be escapes us. But we can point out one of the disadvantages. Once again, it is made evident that research is a political football, the fiscal whipping boy. Once again, all those engaged in it are reminded that they are second-class citizens.

This is just at the time when the mammoth lunar exploration program is being cranked up. Research is going to be the guts of that program. If the industry and the nation are to obtain maximum benefits from the multi-billion-dollar lunar project, serious consideration must be given to the type and direction of the research involved.

The lunar program can provide the nation with a giant step forward in the technology which is this country's lifeblood. We are talking not merely about space technology but about the complete spectrum of this nation's scientific and industrial technology. Fallout from the lunar program could be exactly the jolt needed to push the U.S. ahead on many frontiers. Or the program could be just so much money poured down a bottomless lunar crater. The direction of the research effort will do much to determine which.

One of the industry's most able spokesmen, Daniel E. Noble, executive vice president of Motorola, put the problem extremely well in a recent issue of a company engineering bulletin. He writes:

"The emphasis of selected areas of research is not only the key to increased speed for all space exploration, but it is also a necessity for the support of our growth economy. The proposed spending of forty billion dollars to reach the moon can be a disastrous and unrealistic drain upon our economy, or it can be a constructive, progressive effort which will not only win for us the position of overwhelming leadership in the weapons race, but will also provide us with an increased spread of employment and a potential for a very substantial increase in the gross national product.

"If the forty billion dollars is spent primarily in an attempt, by brute force methods, to extend the space exploration capability of our comparatively primitive skyrockets, we will be faced with a disastrous waste of money. If we recognize that real speed is not achieved by brute force methods; if we recognize that the solution to a more sophisticated space flight capability lies in the laboratories; if we recognize the significance and the promise of the trend in applied science away from the macroscopic and toward the microscopic approach to materials and to solid state electronics, and if we balance a reasonable program of space flight testing with generous, vigorous, and selective pure and applied research programs which are based upon the identification and backing of men with ideas, we will not only end up with an overwhelming superiority in the field of space exploration, but we will open up a new source of essential custom-made materials and scientific information which will pace the continuing expansion of our technological culture and insure the continuing health of our economy.

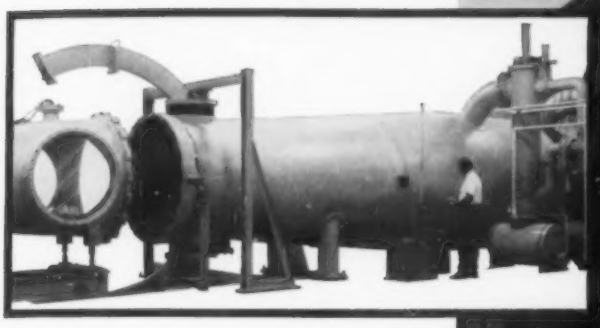
"We know that the continuing increase in our gross national product is essential to our economic health and 'every schoolboy knows' that this expansion capability is tied to the availability of new scientific information which must come from effective pure research and applied research. I repeat that the spending of forty billion dollars for a skyrocket to the moon can be disastrous or it can be the most constructive, important and successful program ever undertaken as a national effort. We have a choice."

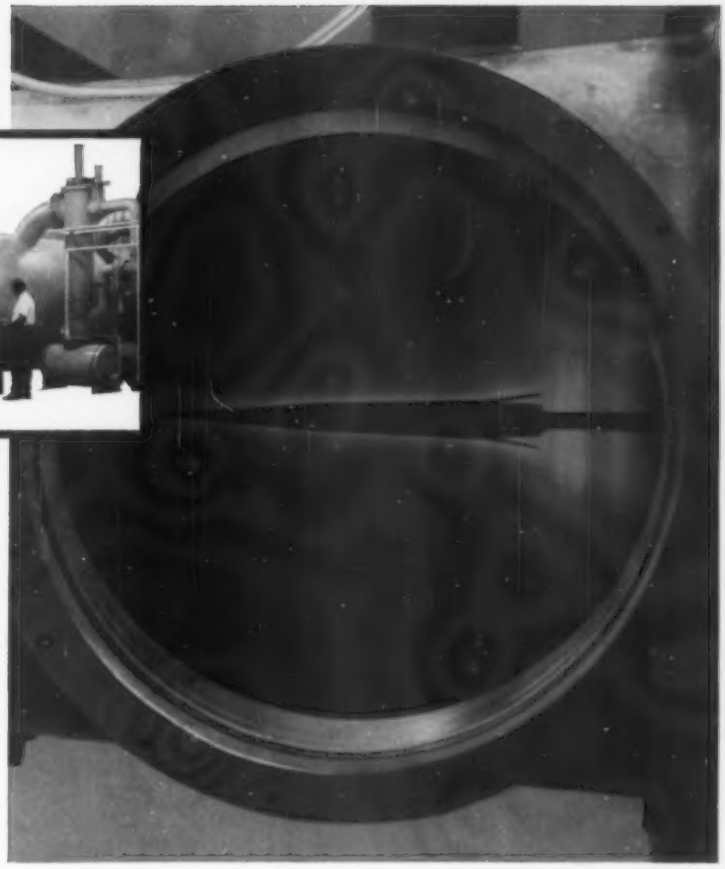
THESE ARE SERIOUS PROBLEMS which NASA must face in determining the direction of the lunar program. Mr. Noble's point that success will depend upon selected emphasis of potentially rewarding areas of research is an important one. Too much time and money can be wasted in trying to do everything in the hope that something will turn out well. The program must have forceful direction into the promising areas. This is not to say that every effort will succeed. There will be failures. But the percentage of success will be considerably higher.

And who must decide which are the most promising areas of research? A group of second-class citizens known as researchers. With the tremendous vote of confidence just given them by Congress on behalf of the nation, we know they are champing at the bit to tackle this great new challenge. They'll get their money in due course, naturally, but it is just as well to remind them, before their new assignment gets under way, of their true standing.

As Mr. Noble points out, pure research is practiced almost exclusively by fanatics who have never learned that where the glamor isn't, the money ain't.

William J. Coughlin





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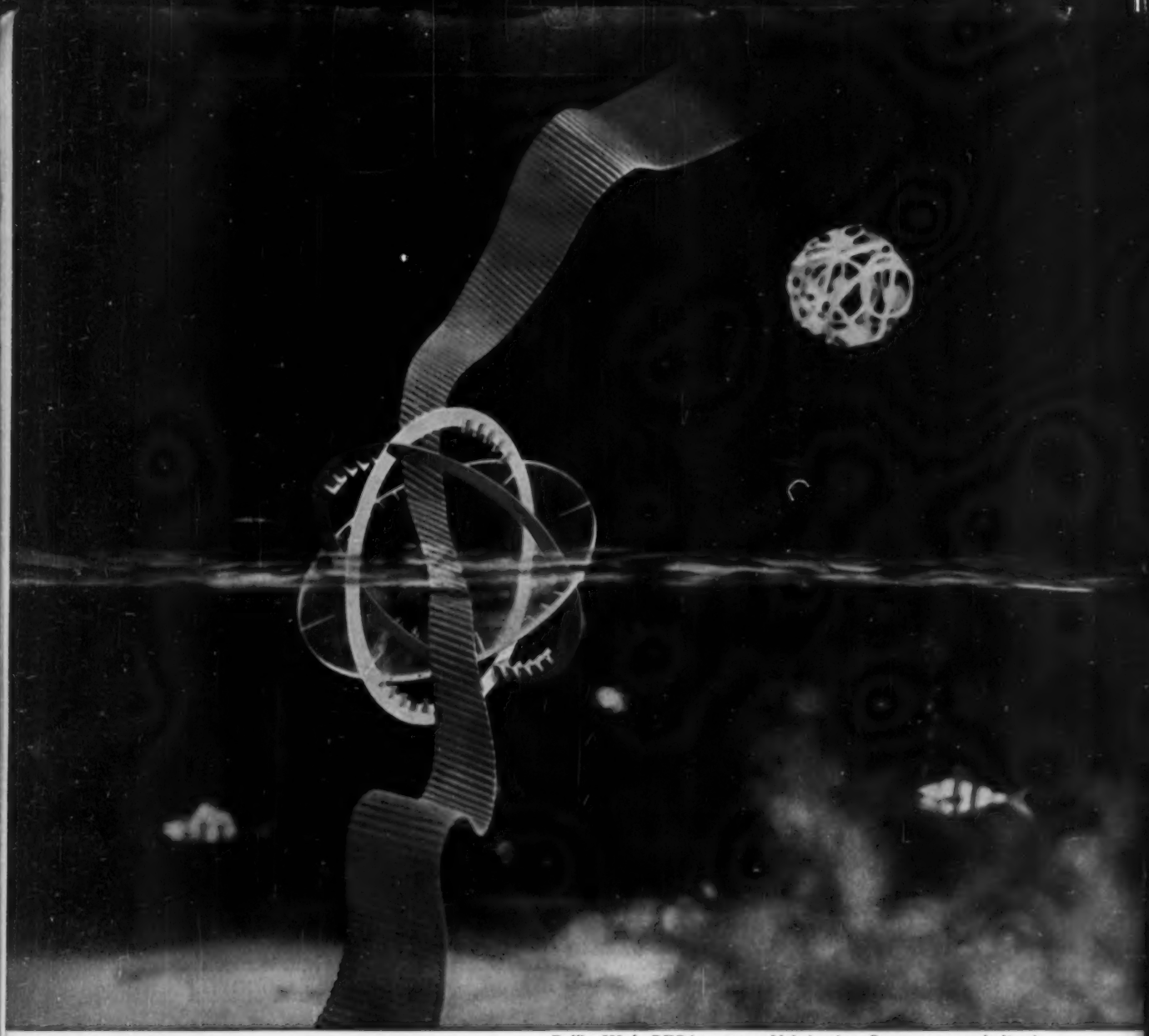

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